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NUCLEAR SCIENCE ABSTRACTS

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Volume 31, Number 9, May 15, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

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CASARETT, A.P., See KALLFELZ, F.A., 30:21411
CASCI, C., Method for preliminary analysis of MHD generator performance, 30:20916 (AGARD-CP-104)

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REACTOR CORES/INSPECTION
Initial results of a holographic tomosynthesis technique for fuel-core inspection, 30:23198
REACTOR CORES/STRESS ANALYSIS
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23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

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Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

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Volume 31, Number 9 May 15, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 23328 and 24584.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 22645, 22802, and 23116.

21976 (N-74-32175) QUANTITATIVE MULTIELEMENT ANALYSIS USING HIGH-ENERGY PARTICLE BOMBARDMENT. Clark, P. J.; Neal, G. F.; Allen, R. O. (Virginia Univ., Charlottesville (USA). Dept. of Chemistry). 1974. 40p. (NASA-CR-139619). NTIS $5.00.

Charged particles ranging in energy from 0.8 to 4.0 MeV are used to induce resonant nuclear reactions. Coulomb excitation (gamma x rays), and x-ray emission occurs in both thick and thin targets. Quantitative analysis is possible for elements from Li to Pb in complex environmental samples, although the matrix can severely reduce the sensitivity. It is necessary to use a comparator technique for the gamma rays, while for x rays an internal standard can be used. A USGS standard rock is analyzed for a total of 28 elements. Water samples can be analyzed either by nebulizing the sample doped with Cs or Y onto a thin formvar film or by extracting the sample (with or without an internal standard) onto ion exchange resin which is pressed into a pellet. (auth)

21977 (PB-236404) CYCLOTRON ANALYSIS OF ATMOSPHERIC CONTAMINANTS. Final Report, 30 Jun 1971–30 Sep 1972. Cahill, T. A. (California Univ., Davis (USA). Crocker Nuclear Lab.). 31 Oct 1972. 73p. (UCD-CNL-162; ARB-R-PCA-038-19). NTIS $4.25.

The report summarizes the results of a one-year effort to develop techniques to perform elemental analysis of atmospheric particulate samples using accelerator beams. The system analyzes elements between sodium and uranium by x-rays, while elements between hydrogen and calcium (excluding Be) are analyzed by elastic alpha-scattering. The maximum throughput per day is about 2400 x-ray analyses (fast); plus 24 x-ray analyses (slow); plus 96 alpha scattering analyses (light elements). Cost ranges between about $1.56/sample and about $10.00/sample for fast analysis, with the price for alpha scattering analysis set at about $20.00/sample when performed in tandem with fast analysis. Design, sensitivity, and procedures are discussed. (GRA)

21978 DEPTH DISTRIBUTION STUDIES OF CARBON IN STEEL SURFACES BY MEANS OF THE NUCLEAR REACTION $^{12}C(p,\gamma)^{13}N$. Lorenzen, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nucl. Instrum. Methods; 121: No. 3, 467-475(1 Nov 1974).

A method is described for measuring the depth distribution of carbon in steel surfaces by means of the nuclear reaction $^{12}C(p,\gamma)^{13}N$. At proton energies of 0.457 MeV and 1.698 MeV the excitation function for this reaction exhibits sharp resonances which have been used to activate the carbon in thin layers beneath the surface. By means of irradiations at selected proton energies this technique facilitates the measurement of the depth distribution of the carbon content. It has been found that this method can be used to reveal carbon concentration profiles down to a depth of 20 μm with a resolution of between 0.26 and 1.7 μm for the two resonances. The detection limit obtained for carbon is 0.1% and the shape of the depth distribution is reproducible to within 15%. Homogeneous as well as inhomogeneous distributions (gradients) have been measured and results are compared with those given by two other methods. An account is given of the restrictions imposed by high currents which give rise to heating effects and radiation damage. (auth)

21979 NUCLEAR MICROPROBE AS AN ANALYTICAL TOOL. Pierce, T. B. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Proc. Soc. Anal. Chem.; 11: No. 12, 333-335(Dec 1974).

A summary is presented of the development and application of a nuclear microprobe in which "prompt" radiation nuclear reactions are combined with the use of an incident ion beam of small diameter. Particular reference is made to the use of the technique for light element determination (including the determination of boron by the reactions $^{10}B(\alpha, p)^{13}C$ and $^{11}B(\alpha, p)^{14}C$). (UK)

21980 SOLID STATE TRACK DETECTORS FOR THE DETECTION OF DEUTERIUM IN WATER. Ettinger, K. V.; Malik, S. R. (Univ. of Birmingham, Eng.). Health Phys.; 28: No. 1, 75(Jan 1975).

The detection of photoneutrons originating from deuterium exposed to photons of energy higher than the binding energy of the deuteron, is described. A ^{235}U foil sandwiched between two plastic films as a fissile foil converter and solid state track detector, was used. The foil sandwich was placed inside a graphite moderator block together with the sample of heavy water and the block placed in front of the bremsstrahlung target of a 3 MeV electron accelerator. The tracks produced by the fission fragments were etched and counted in the usual way. It was found that the number of tracks is proportional to the concentration of deuterium in the sample and to the total dose of bremsstrahlung imparted to the sample. (UK)

21981 CADMIUM: ITS IN VIVO DETECTION IN MAN. McLellan, J. S.; Thomas, B. J.; Fremlin, J. H.; Harvey, T. C. (Univ. of Birmingham, Eng.). Phys. Med. Biol.; 20: No. 1, 88-95(Jan 1975).

Neutron capture γ-ray analysis was applied to the in vivo detection of Cd in man. The technique was designed for the screening of industrial workers at risk. The limit of sensitivity in a liver-sized phantom is 0.5 ppm for a dose of 0.4 rad. Reproducibility and the effects of positional uncertainties have been investigated. A number of cadavers were studied to establish normal limits prior to commencement of a programme of clinical investigation. A patient with a known Cd poisoning was estimated to contain 65 to 110 ppM of Cd in his liver. A liver dose of 0.5 rad was required. (auth)

21982 MEASUREMENT OF CALCIUM IN SECTIONS OF A HUMAN SKELETON USING A REACTOR SPECTRUM: IN VIVO ACTIVATION ANALYSIS TECHNIQUE. Boddy, K.; Glaros, D.; Robertson, I. (Scottish Research Reactor Centre, East Kilbride, Eng.). Phys. Med. Biol.; 20: No. 1, 80-87(Jan 1975).

Factors influencing the precision of measuring changes in the calcium content of sections of bone, including vertebrae, using reactor neutrons for partial body in vivo activation analysis were examined and quantified. These factors included the choice of incident neutron spectrum, the uniformity of activation with depth in the body, reproducibility, interfering reactions, sensitivity, and dosimetry. It was concluded that an overall precision of 2.8 to 3.2% (coefficient of variation) could be attained with a neutron dose of 50 mrad or 3 to 4% with a dose as low as 20 mrad. (auth)

21983 INSTRUMENTAL MULTIELEMENT PROTON ACTIVATION ANALYSIS OF HIGH-PURITY NIOBIUM USING BOTH γ-RAY AND X-RAY SPECTROMETRY. Krivan, V. (Texas A and M Univ., College Station). Anal. Chem.; 47: No. 3, 469-478(Mar 1975).

Trace concentrations of nine metallic impurities have been determined simultaneously in high-purity niobium by a nondestructive technique based on irradiation of the sample with 12-MeV protons and observation of both the γ- and x-rays from the reaction products with a Ge(Li) and a germanium low energy detector, respectively. The activation of the trace elements is based on (p,n) reactions. The elements determined are: Ti, V, Cr, Fe, Zr, Mo, Hf, Ta, and W. Three other elements, i.e., Pd, Sn and Sb, could have been determined with high sensitivities if at all present. For Ti, V, Fe, Zr, and Mo, this method is more sensitive than other techniques which have been applied to the determination of these elements in niobium excluding solid mass spectrography. Detailed data on possible interferences, precision, and limits of detection are given. (auth)

21984 FORENSIC DATA ANALYSIS BY PATTERN RECOGNITION. Categorization of White Bond Papers by Elemental Composition. Duewer, D. L.; Kowalski, B. R. (Univ. of Washington, Seattle). Anal. Chem.; 47: No. 3, 526-530(Mar 1975).

Pattern recognition techniques have been applied to the analysis of white bond papers as analyzed by neutron activation analysis. Separation, without arbitrary procedures, has been achieved for groupings made by paper grade and by paper manufacturer. The utility of several elements in the above separations has been assessed. Pattern recognition is recommended as a useful tool in certain analytical and forensic applications. (auth)

21985 SELECTIVE CHEMICAL SEPARATION PROCEDURES FOR ACTIVATION ANALYSIS. P. 2. Separation of Arsenic by Column Extraction With Tin(II) Ethylxanthate. Determination in Titanium Dioxide of High Antimony Content and in Biological Materials. Erdtmann, G.; Aboulwafa, O. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Analytische Chemie). Z. Anal. Chem.; 272: No. 2, 105-114(Nov 1974).

From GDCh-Symposium "trace analysis"; Erlangen, F. R. Germany (2 Apr 1973).

The determination of small amounts of arsenic in the presence of antimony requires separation of arsenic after irradiation, because the γ lines of the radionuclides ^{76}As and ^{122}Sb are so close together that they usually cannot be fully separated by γ spectrometry. Arsenic is selectively extracted from 10M HCl solutions with ethylxanthate. This extraction permits the separation of nearly all other elements including antimony. From this reaction a selective, one-step column extraction procedure for arsenic was developed. As(III) is quantitatively retained on columns coated with chloroform solutions of tin(II) ethylxanthate. The separation power of these columns for As(III), Sb(III), Se(IV) and some other elements was studied. The procedure was applied to the determination of arsenic in titanium dioxide samples containing a comparatively large amount of antimony and in biological material. (auth)

21986 PHOTON ACTIVATION OF BIOLOGICAL SAMPLES AND PATIENTS IRRADIATED WITH A BETATRON. Kairento, A. L.; Nikkinen-Vilkki, P. (Helsinki Univ. (Finland). Radiotherapy Clinic). Strahlentherapie; 148: No. 2, 155-162(Aug 1974).

A medical betatron (asklepitron 35) was employed for irradiation of biological samples, viz blood, plasma, lung, liver, thyroid gland and heart, with photons of 33 MeV maximum energy. The radiation induced by the activation was measured with Ge(Li) detectors. In all, 11 different elements were observed: Mg, Cl, Ca, Cr, Mn, Fe, Ni, Cu, Zn, I, and Pb. The sensitivity of the method of measurement was approximately of the order of μg, and the mean accuracy in the determination of quantities of elements was ± 10%. Studies were also made of the activation that occurred during radiotherapy treatment of patients similarly irradiated for pulmonary or collum carcinoma. Measurements made with 11 patients showed that the elements Mg, Cl, Ca, Cr, Fe, Ni, Zn, Sr, Sn, and Pb were detectable. (auth)

21987 DETERMINATION OF TRACE ELEMENTS IN BIOLOGICAL MATERIAL BY NEUTRON ACTIVATION ANALYSIS. Van Den Winkel, P. Ghent; State Univ. of Ghent (1969). vp. Available from the Library of the State Univ. of Ghent, Belgium.

Thesis (Ph. D.).

Several separation schemes for the determination of main (Na, K, P, S) and trace (Ag, Au, As, Co, Cu, Fe, Hg, Mn, Mo, Se, Sc, Zn) constituents in biological samples by means of radioactivation analysis with reactor neutrons are presented. The materials analyzed are blood, brain tissue, and kale powder. (LK)

21988 ANALYSIS OF CHLORINE BY PROMPT GAMMA RAYS INDUCED BY PROTONS. Deconninck, G.; Debras, G. (Univ., Namur, Belgium). Radiochem. Radioanal. Lett.; 20: No. 3, 175-181(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

The elemental determination of chlorine by detection of γ emission following low-energy proton bombardment is explored. The intensity of (p,γ), $(p,p'\gamma)$ and $(p,\alpha\gamma)$ reactions on ^{35}Cl and ^{34}Cl in thick sample are given for proton energy ranging between 1 and 3 MeV. The sensitivity of the method is limited, the detection of 1% of chlorine is possible in a small sample. The application of the method to the determination of isotopic ratios to nonradioactive tracking of chlorine is discussed. (auth)

21989 ACTIVATION ANALYSIS OF TRACE ELEMENTS IN SERUM. Varcoe, F. T. Jr. Gainesville, FL; Univ. of Florida (1974). 213p. University Microfilms Order No. 75-3536.

Thesis (Ph. D.).

This research deals with radiochromatographic separations in neutron activation analysis of trace elements in serum. Understanding the metabolic roles of trace elements as well as their toxicological effects in biological systems has been limited by the sensitivity and selectivity of existing analytical techniques. The lack of human serum concentration data for many trace elements prevents optimum clinical utilization of this extremely powerful diagnostic tool. Neutron activation analysis has extremely low limits of detection for a large number of elements. However, interference from those elements present in human serum at relatively high levels must be eliminated before even a high-resolution solid state detector can be effective. The utilization of high sensitivity sodium iodide detectors requires still more separation. Chromatographic separations of metal chelates were developed for both pre- and postirradiation separations. Quantitative elution from the gas chromatographic column for fluorine substituted betadiketonate complexes of Cr, Cu, Mn, Fe, Be, Lu, and Gd was studied; recoveries between 52 and 92% were found. Extensive studies of decomposition and adsorption losses in the system are reported. Construction and evaluation of various sampling systems, transfer lines, and counting geometries are included. A completely reversible counting geometry for radioactive metal chelates using wide-range temperature and carrier gas control to trap and subsequently release eluate fractions is described. Also included is an apparatus for carrying out chelate separations from solutions whose large volumes preclude gas chromatographic injection. The successful use of a chelating ion exchange resin in human serum neutron activation analysis is reported. Operating conditions which optimize sodium removal with respect to sample loss are described. (Diss. abstr. int., B)

21990 SEPARATION OF RARE EARTHS BY AN ION-EXCHANGE METHOD. Determination of Impurities in High-Purity Rare Earth Oxides. Kubota, M. (Japan Atomic Energy Research Inst., Tokai). J. Radioanal. Chem.; 23: No. 1-2, 73-82 (1974).

Establishment of a generalized method of separating and analyzing trace impurities of high-purity rare earth oxides was attempted by neutron irradiation. The amount of the target materials and the size of the ion-exchange columns used for the analysis were made uniform. The element with atomic number lower by one was added to the irradiated target solution, prior to the cation-exchange separation, in an amount comparable to that of the carrier. α-Hydroxyisobutyrate solutions of various concentrations were used as eluent, the pH value always being kept constant at 3.77. By this method, impurities of Gd, Dy, Ho and Er in Tb_4O_7, Dy, Er and Yb in Ho_2O_3, and Sc, Eu, Tb and Tm in Yb_2O_3 were determined. (auth)

21991 DETERMINATION OF SOME NOBLE METALS AND COPPER BY DESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF DIFFERENT MATRICES. Caramella-Crespi, V.; Pisani, U.; Ganzerli-Valentini, M. T.; Meloni, S.; Maxia, V. (CNR, Pavia, Italy). J. Radioanal. Chem.; 23: No. 1-2, 23-31 (1974).

Neutron activation analysis of palladium, iridium, platinum, gold, silver, and copper in different matrices was carried out by using inorganic adsorbers such as molybdenum dibromide, zinc ferrocyanide, and cadmium metal for their radiochemical separation. The matrices chosen to show the versatility of the method were: high-purity copper and nickel metals, NBS standard reference material SRM 1471 (Orchard leaves), Pultusk meteorite, and the U.S. Geological Survey standard rock W-1. The method elaborated is very simple as it involves only a few steps and it has been shown to be accurate and capable of yielding reliable results. (auth)

21992 COMPUTER PROGRAM FOR AUTOMATIC GAMMA-RAY SPECTRA ANALYSIS WITH ISOTOPE IDENTIFICATION FOR THE PURPOSE OF ACTIVATION ANALYSIS. Weigel, H.; Dauk, J. (Univ., Cologne). J. Radioanal. Chem.; 23: No. 1-2, 171-187(1974).

A FORTRAN IV program for a PDP-9 computer, with 16 K storage capacity, was developed for performing automatic analysis of complex γ spectra, taken with Ge(Li) detectors. It searches for full energy peaks and evaluates the peak areas. The program features an automatically performed isotope identification. It is written in such a flexible manner that after reactor irradiation, spectra from samples of any composition can be evaluated for activation analysis. (auth)

21993 ARSENIC CONCENTRATIONS AND DISTRIBUTION IN CHAUTAUQUA LAKE SEDIMENTS. Ruppert, D. F.; Hopke, Ph. K.; Clute, P.; Metzger, W.; Crowley, D. (State Univ. Coll., Fredonia, NY). J. Radioanal. Chem.; 23: No. 1-2, 159-169 (1974).

In order to describe the occurrence and to investigate the sources of arsenic found in Chautauqua Lake sediments, 98 grab samples have been analyzed by neutron activation analysis. The arsenic concentrations were found to range from ≤ 0.5 to 58.75 ppm for 96 of the 98 samples with an overall average value of 22.10 ppm. The two other samples had concentrations of 140.0 and 306.0 ppm. High arsenic concentrations have been positively correlated with a decrease in the sediment particle size. Natural arsenic concentrations found in the soil and bedrock in the area do not explain the observed concentrations in the lake sediment. The increase in arsenic appears to be related to the spraying of sodium arsenite as an aquatic pesticide during the period 1955-1963. (auth)

21994 CROSS-CORRELATION ANALYSIS OF Ge(Li) SPECTRA. MacDonald, R.; Robertson, A.; Kennett, T. J.; Prestwich, W. V. (McMaster Univ., Hamilton, Ont.). J. Radioanal. Chem.; 23: No. 1-2, 123-130(1974).

A sensitive technique is proposed for activation analysis using cross-correlation and improved spectral orthogonality achieved through use of a rectangular zero area digital filter. (auth)

21995 DETERMINATION OF TIN IN BIOLOGICAL SAMPLES. Ooms, P. C.; van Woerkom, R.; Das, H. A. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 23: No. 1-2, 33-41 (1974).

A rapid method is described for the determination of tin in biological material, using ^{123}Sn (T = 40 m). The chemical procedure is based on the nearly quantitative extraction of tetravalent tin into toluene from an acid 1.3M iodide solution. The recovery is determined by spiking the solution with ^{113}Sn and measuring the activity of the ^{113m}In daughter in the counting sample. The lower limit of the determination is ≈0.01μg. Results are given for standard kale powder and dried animal blood. (auth)

21996 INVESTIGATION OF GAMMA-SPECTRA OF BIOLOGICAL MATERIALS IRRADIATED IN THE EPITHERMAL RANGE OF THE REACTOR NEUTRON SPECTRUM. Bagdavadze, N. V.; Mosulishvili, L. M. (Inst. of Physics, Tbilissi, USSR). J. Radioanal. Chem.; 24: No. 1, 65-72(1975).

Irradiation of various biological materials in the nuclear reactor neutron epithermal flux allows the increase of the selectivity of the pure instrumental method of activation analysis for the definite set of tracers either not determined instrumentally during sample irradiation by the thermal neutron flux or determined with low sensitivity. The given paper describes a method of increasing the sensitivity of the instrumental neutron activation determination of As, Br, Mo, Cd, Sb, W, and Au in biological materials at the level of the whole blood, tissue, and subcellular components. (auth)

21997 MULTIELEMENT ANALYSIS OF MINOR COMPONENTS USING A 14-MeV NEUTRON GENERATOR. Gangadharan, S.; Yegnasubramanian, S.; Misra, S. C. (Bhabha Atomic Research Centre, Bombay). J. Radioanal. Chem.; 24: No. 1, 57-64 (1975).

14-MeV neutron activation was used for the determination of F, Al, Si, P, K, Mn, Mo, and W in minerals and steel. Most of these elements were estimated simultaneously through gamma spectrometry. The evaluation of the effects of interferences is discussed and the sensitivities are given. The main features of the neutron generator fabricated in this Centre and used in this work are briefly described. (auth)

21998 SINGLE-COMPARATOR METHODS IN REACTOR NEUTRON ACTIVATION ANALYSIS. Simonits, A.; De Corte, F.; Hoste, J. (Rijksuniversiteit, Ghent). J. Radioanal. Chem.; 24: No. 1, 31-46(1975).

A critical evaluation of different comparator methods is given. The method based on experimentally determined and convertible comparison factors (k) is considered to be the most suitable for general use. An alternative method is proposed, introducing generalized k_0 factors which are independent of irradiation and measuring conditions. This approach combines the simplicity of the absolute methods with nearly the same accuracy attained by the relative ones. It is suggested that k_0 factors be compiled in all cases when using single-comparator methods, to allow a continuous re-evaluation. (auth)

21999 GAMMA-RAY TABLES FOR NEUTRON, FAST NEUTRON, AND PHOTON ACTIVATION ANALYSIS. I. List of All the Nuclides with Their Associated Gamma-Rays in Order of Increasing Atomic Number and Mass. Lis, S. A. (State Univ. Coll., Fredonia, NY); Hopke, Ph. K.; Fasching, J. L. J. Radioanal. Chem.; 24: No. 1, 125-247(1975).

In the past several years, a number of gamma tables have been published. All of the tables limit themselves to those nuclides formed in (n,γ) reactions or at most to a few of the more prominent (n, 2n) products. A number of investigators are developing activation analysis methods using fast neutrons or photons. These investigations have been hampered by the lack of tables of gamma-rays of those nuclides that can be formed by (n, 2n), (n, p), (n, α), (n, n') and (n, d) reactions. Since (γ, n) yields the same product as (n, 2n) the table would also be useful to photon activation studies. The authors have compiled such a table. Section II: list of the gamma-rays for all isotopes in order of increasing energy will be published in the J. Radioanal. Chem., 25 (1975) No. 2. (auth)

22000 NUCLEAR RADIATION SPECTROMETRIC METHOD APPLIED TO MEASUREMENTS OF AIR CONTAMINATION WITH DUST. Jagielak, J.; Gwiazdowski, B.; Krzesniak, J.; Sapiecha, H.; Zak, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). Postepy Fiz. Med.; 8: 23-31(1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Thanks to developments in spectrometric detectors of nuclear radiation, methods based on spectral energy analysis have become ever more essential in research and routine procedures. Possibilities are presented for air contamination investigations opened by the introduction of the above methods. A special spectrometric set-up equipped with scintillation detectors and a pulse chamber for air contamination measurements were developed. Methods for measuring nonradioactive contamination of air are described. They make use of neutron activation analysis and x-ray fluorescent techniques. A spectrometric system for these measurements, provided with Ge(Li) and Si(Li) detectors is also presented. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 22602, 22646, 22649, 22843, and 22845.

22001 (AD-787742) SURVEY OF MANUAL METHODS OF MEASUREMENTS OF ASBESTOS, BERYLLIUM, LEAD, CADMIUM, SELENIUM, AND MERCURY IN STATIONARY SOURCE EMISSIONS. Final Report, 29 Jun 1971-30 Sep 1973. Coulson, D. M.; Haynes, D. L.; Balazs, M. K.; Dolder, M. P. (Stanford Research Inst., Menlo Park, Calif. (USA)). 30 Sep 1973. 162p. (SRI-PYU-1374). NTIS $6.25.

The purpose of this study is to evaluate existing manual methods for analyzing asbestos, beryllium, lead, cadmium, selenium, and mercury and from this evaluation to provide the best and most practical set of analytical methods for measuring emissions of these elements from stationary sources. The work performed in this study was divided into two phases. Phase I was limited to surveying sources of information and summarizing the findings in terms of existing methods; totally new methods were not developed. However, in the case of asbestos and mercury it was necessary to modify existing methods significantly, and some laboratory and field testing was performed during Phase I to develop these two methods. Phase II was concerned with the testing, evaluation, and modification of the methods of analysis developed during Phase I. Both laboratory and field tests were conducted during this phase of the work. (GRA)

22002 (BARC-761) SOME PROBLEMS IN COMPLEXOMETRY. Shetty, S. Y.; Maiti, B.; Mahadevan, N.; Sathe, R. M. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

The characteristics of complexometry using EDTA as the titrant are tabulated and expressions for the absolute and conditional constants and the rise in pM are derived. The use of the

Hg/Hg EDTA electrode and the precautions which must be taken with it are discussed. The modifications to EDTA complexometry in the sequential determination of Th and the rare earths, determination of Ca in the presence of Mg, and the determination of Cu and Mg and Cu–Be–Mg alloys are described. (JSR)

22003 (CEA-R-4620) PROBLEMS CONNECTED WITH THE GAS PHASE CHROMATOGRAPHIC ANALYSIS OF TRACES OF RARE GASES IN GAS PURIFICATION AND CONCENTRATION LINES. Charrier, G.; Lutz, M.; Alba, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Jan 1975. 21p. (In French). Dep. NTIS (US Sales Only) $4.25.

The problems posed by the matrix in the analysis of gas traces are discussed. The different methods of overcoming the obstacles raised by this generally complex matrix are described. The study is chiefly devoted to rare gases, and two main lines of research are developed: sample treatment (concentration on uranium furnace and preparative chromatography) in order to change the nature of the matrix, definition of the analytical conditions (suitable choice of carrier and gas order of elution of the different gases in the mixture). In concentration of a few tens of ppb rare gases can be measured by this technique. (auth)

22004 (N-74-26032) COMPARISON OF INERT-GAS-FUSION AND MODIFIED KJELDAHL TECHNIQUES FOR DETERMINATION OF NITROGEN IN NIOBIUM ALLOYS. Merkle, E. J.; Graab, J. W.; Davis, W. F. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1974. 16p. (NASA-TM-X-3067). NTIS $3.00.

Results are compared for the determination of nitrogen in a selected group of niobium-base alloys by inert-gas-fusion and Kjeldahl procedures. In the inert-gas-fusion procedure, the sample is heated to approximately 2700°C in a helium atmosphere in a single-use graphite crucible. A platinum flux is used to facilitate melting of the sample. The Kjeldahl method consisted of a rapid decomposition with a mixture of hydrofluoric acid, phosphoric acid, and potassium chromate; distillation in the presence of sodium hydroxide; and highly sensitive spectrophotometry with nitroprusside-catalyzed indophenol. In the 30- to 80-ppM range, the relative standard deviation was 5 to 7% for the inert-gas-fusion procedure and 2 to 8% for the Kjeldahl procedure. Agreement between the two techniques is considered satisfactory. (auth)

22005 (NIM-1598) USE OF CARBON-ROD DEVICES IN THE DETERMINATION OF NOBLE METALS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Pearton, D. C. G.; Mallett, R. C. (National Inst. for Metallurgy, Johannesburg (South Africa)). 20 Mar 1974. 14p. INIS.

A comparison is made of the Mini-Massman, the NIM rod, and the carbon tube, with respect to sensitivity, precision, and interference. Of the three devices, the carbon tube was found to be the most sensitive and precise, to have the lowest limit of detection, and to be accompanied by the least interference. Its sensitivity is much higher than that for a flame cell, and its precision is equally high. The determination of palladium by the use of the graphite-tube device was studied from the point of view of interference and the effect of some releasing agents. There was some evidence that volatilization was suppressed by elements that have high boiling points and that are non-volatile under the analytical conditions. Of the releasing agents examined (uranium, vanadium, lanthanum, copper, and cadmium), cadmium was the most effective. (auth)

22006 (REG/G-5.39(12-74)) GENERAL METHODS FOR THE ANALYSIS OF URANYL NITRATE SOLUTIONS FOR ASSAY, ISOTOPIC DISTRIBUTION, AND IMPURITY DETERMINATIONS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Dec 1974. 2p. DRS Free.

This guide identifies methods acceptable to the Regulatory staff for chemical, isotopic, and impurity analyses which an applicant may specify as part of his procedures for accounting for special nuclear material. (auth)

22007 (UCID-15527(Rev.1)) MANUAL OF CONTROLLED-POTENTIAL COULOMETRIC METHODS. Harrar, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1973. 55p. Dep. NTIS $5.75.

Most of the published controlled-potential coulometric methods for inorganic substances (many of which have been checked in the author's laboratory) are listed together with their procedural details and interferences. Methods are given for Am, Sb, As, Ba, Bk, Bi, Br^-, Cd, Ce, Cl^-, Cr, Co, Cu, Eu, $Fe(CN)_6^{4-}$, Au, Ac, H_2O_2, In, I^-, Ir, Fe, Mn, Mo, Np, Ni, NO_3^-, NO_2^-, Pu, Po, Rh, $RuCl_6^{3-}$, Ru, Ag, Tc, Tl, Sn, Ti, U, V, and Zn. (LK)

22008 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM BY EXTRACTION OF ITS THIOSULPHATE COMPLEX. Yatirajam, V.; Ram, J. (Kurukshetra Univ., India). Talanta; 21: No. 12, 1308-1311(Dec 1974).

A simple and rapid spectrophotometric determination of molybdenum is described. The molybdenum thiosulfate complex is extracted into isoamyl alcohol from 1.0 to 1.5 M hydrochloric acid containing 36 to 40 mg of $Na_2S_2O_3 \cdot 5H_2O$ per ml. The absorbance at λ_{max} = 475 nm obeys Beer's law over the range 0 to 32 μg of Mo per ml of solvent phase. Up to 5 mg/ml of Ti(IV), V(V), Cr(VI), Fe(III), Co(II), Ni(II), U(VI), W(VI), Sb(III), 1 mg/ml of Cu(II), Sn(II), Bi(V) and 10 μg/ml of Pt(IV) and Pd(II) do not interfere. Large amounts of complexing agents interfere. The method has been applied to analysis of synthetic and industrial samples. (auth)

22009 APPLICATION OF HIGH VOLTAGE ELECTROPHORESIS ON THE SEPARATION OF RADIONUCLIDES. IV. Radioreagent Method in the Carrier Electrophoresis of Inorganic Ions. Buchtela, K. (Univ., Vienna). Mikrochim. Acta; 1: No. 1, 1-11 (1975). (In German).

Rare earth elements are analyzed with radioactive reagents after separation by high voltage electrophoresis. The radioactive reagent migrates towards the spots on the electropherogramm, the radioactive product does not migrate in the electric field. Radioactive reagents can also be used for the determination of carrier material of radioactive labelled ions. A radioactive product is set free from a radioactive precipitate by reacting with the ion to be analyzed. The radioactive product migrates in an electric field and is determined radiometrically. (auth)

22010 $^{18}O/^{16}O$ OF FELDSPARS IN CARBONATE ROCKS. Lawrence, J. R. (Columbia Univ., Palisades, NY); Kastner, M. Geochim. Cosmochim. Acta; 39: No. 2, 97-102(Feb 1975).

Six authigenic feldspars and three detrital feldspars in limestones and dolostones of Eocene to Precambrian ages were analyzed for their $^{18}O/^{16}O$ content. The difference in $\delta\ ^{18}O$ between the authigenic feldspars ($\delta\ ^{18}O$ range = 18.2 to + 24.7 ‰) and carbonate host rocks, both limestones and dolostones, was found to be −0.5 to −1.4 ‰. Detrital feldspars ($\delta\ ^{18}O$ = +11.2, +22.5, and +17.0 ‰) exhibit Δ feldspar/carbonate values of −12.0, −2.4 and −1.6 ‰, respectively, and appear to have undergone increased isotopic exchange as a function of decreased grain size under solid-state conditions. (auth)

22011 SPECTROPHOTOMETRIC DETERMINATION OF MICRO-AMOUNTS OF COBALT IN URANIUM OXIDE, PURE URANIUM, AND A URANYL SALT WITH 2-NITROSO-5-DIMETHYLAMINOPHENOL. Motomizu, S. (Okayama Univ., Japan). Analyst; 100: No. 1186, 39-45(Jan 1975).

Micro-amounts and trace amounts of cobalt in uranium oxide (U_3O_8), uranium and a uranyl salt were determined spectrophotometrically with 2-nitroso-5-dimethylaminophenol (nitroso-DMAP) reagent. According to the cobalt content (above 0.01 ppm) of the sample, four methods for determining cobalt are recommended. By use of one method, cobalt in a sample containing more than 5 ppm of cobalt was determined in aqueous solution, while by use of the other three methods, cobalt in samples containing more than 0.5, 0.1 and 0.01 ppm, was determined by a solvent-extraction-spectrophotometric method. (auth)

22012 DETERMINATION OF MOLYBDENUM IN PLANTS BY AN AUTOMATED CATALYTIC METHOD. Bradfield, E. G.; Stickland, J. F. (Long Ashton Research Station, Bristol, Eng.). Analyst; 100: No. 1186, 1-6(Jan 1975).

Molybdenum is determined by its catalytic effect on the liberation of iodine from the reaction between potassium iodide and hydrogen peroxide. The detection limit is 0.003 μg ml^{-1} of molybdenum. Interference from iron and tungsten can be overcome by addition of ammonium fluoride, but for the greatest precision and accuracy a preliminary separation of molybdenum as its benzoin α-monoxime complex is recommended. Molybdenum concentrations determined by the proposed method in some reference plant materials are presented. (auth)

22013 COMPARISON OF AN INSTRUMENTAL AND MODIFIED KJELDAHL TECHNIQUE FOR DETERMINATION OF NITROGEN IN NIOBIUM AND TANTALUM ALLOYS. Merkle, E. J.; Graab, J. W.; Davis, W. F. (National Aeronautics and Space Administration, Cleveland). Talanta; 21: No. 12, 1317-1320(Dec 1974).

Results obtained for the determination of nitrogen in two tantalum alloys and six niobium alloys by modified Kjeldahl and Leco TC-30 nitrogen-oxygen determinator are compared. In the 5 to 25 ppm range, for tantalum alloys, the relative standard deviation was 3 to 9% by the Kjeldahl procedure and 9 to 11% by the instrumental technique. In the range 30 to 80 ppm, for niobium alloys, the relative standard deviation was 2 to 8% by the Kjeldahl procedure and 5 to 7% by the instrumental technique. (auth)

22014 PROGRAM TO PROCESS STEEL-ANALYSIS DATA FROM AN ARL 72000 X-RAY FLUORESCENCE SPECTROMETER. Tunney, A. A. (British Steel Corp., Sheffield, Eng.). Brit. Steel Corp., Open Rep.; vp(1973).

A computer program (in ALGOL 60) is briefly described that corrects for changes in calibration graphs caused by instrumental drift and also for, e.g., line overlap. The performance of the program in correcting for drift is demonstrated, and precisions attained over a 7-month period in determinations of Si, Mn, P, S, Cr, Mo, Ni, Cu, Nb, Sn, Ti, and V are tabulated. It is concluded that, although the precision is less good than anticipated, the program affords over-all analytical performance and is adaptable to any direct-reading instrument. (Anal Abstr.)

22015 DETERMINATION OF ^{15}N BY ELECTRODELESS DISCHARGE. Scott, T. A.; Humpherson, R. (Univ. of Leeds, Eng.). Lab. Pract.; 23: No. 12, 703-705; 715(Dec 1974).

The construction and operation of an apparatus used to determine the relative abundance of ^{14}N and ^{15}N and thus the percentage of ^{15}N in a sample, by electrodeless discharge, are described. The gas sample was placed in a sealed tube at a pressure of between 1 and 7 torr and the tube positioned across the output terminals of a high-frequency radio transmitter light from the excited gas was analyzed. Since isotope shifts for the $2 \rightarrow 0$ transition are relatively large the band at 2976.8 Å and its accompanying isotopic shifts was used for the work. Methods of preparation of the nitrogen gas for isotopic analysis are considered. The high-frequency generator and power supply, the monochromator, the photomultiplier and HV supply unit and the amplifier and power supply are each described. The preparation of the discharge tubes is discussed. (UK)

22016 ACIDIMETRIC DETERMINATION OF ALKALINE NITRATES IN PROTOGENIC MEDIA. Subert, J.; Biskupova, B. (Komenskeho Univ., Bratislava). Chem. Prumysl; 24: No. 12, 627-629(1974). (In Czech).

Nitrates of alkaline metals can be successfully determined (after reduction with formic acid) by acidimetric titration by a solution of perchloric acid in a non-aqueous protogenic medium of suitable composition, using either visual indication with crystal violet or potentiometry. The mixture acetanhydride + acetic acid + formic acid (15 + 15 + 2 ml) seems to be a generally applicable reaction medium. The elaborated analytical procedure is simple and rapid and therefore more useful than the time-consuming sulfate-based gravimetric determination and other methods. (auth)

22017 RELATIVE PHOTOELECTRON SIGNAL INTENSITIES OBTAINED WITH A MAGNESIUM X-RAY SOURCE. Berthou, H.; Jorgensen, C. K. (Univ., Geneva). Anal. Chem.; 47: No. 3, 482-488(Mar 1975).

X-Ray photoelectron spectroscopy has often been used for quantitative (or semiquantitative) analysis of metallic or alloyed samples. Since people use either an aluminum or a magnesium X-ray source, the relative photoelectron signal intensities of 76 elements are compared for both sources. Differences arise though the same intensity behavior is observed. Further on, the relative reproducibility is much better with a high-intensity magnesium source (10 to 15%) than with aluminum (20 to 30%). The intensity variation cannot be straightforwardly correlated with the 233-eV difference between the photon energies 1486.6 and 1253.6 eV. In a few cases, a kind of sharing due to secondary processes such as shake-up or multiplet splitting might explain the discrepancies from the values expected using the ratios of theoretical photoionization cross-sections. (auth)

22018 SPECTROGRAPHIC A. C. SPARK METHOD FOR THE ESTIMATION OF YTTRIUM IN RARE EARTH MIXTURES. Grampurohit, S. V.; Sethumadhavan, A. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). Z. Anal. Chem.; 272: No. 1, 25-26(Oct 1974).

1 fig.; 2 tabs.; 6 refs.

The spectrographic estimation of yttrium in rare earth mixtures was achieved within a concentration range of 1 to 90% by means of the a.c. spark method using a large quartz spectrograph. The sample was mixed with ceria and zinc oxide in the ratio 2:1:2. The Y lines 2,414.68 and 2,856.36 Å were used as analytical lines for the ranges of 1 to 15% and 10 to 90%, respectively. The Ce line at 2,603.65 Å served as internal standard line. The standard deviation was 2 to 5%. (auth)

22019 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM BY EXTRACTION AS THE MOLYBDENUM–QUINOLINE–THIOCYANATE MIXED COMPLEX. Rao, V. P. R.; Anjaneyulu, Y.; Krishna Murty, A. S. R. (Andhra Univ., Andhra Pradesh, India). Mikrochim. Acta; 1: No. 2-3, 265-270(1975).

Molybdenum(VI) is reduced to the pentavalent state very rapidly in the presence of thiocyanate and quinoline (or similar bases) in 2.5 M hydrochloric acid medium. It distributes into nitrobenzene as $[MoO(Qn)_2(SCN)_3]$ giving an orange-red extract with maximum absorbance at 470 nm and molar absorbance 18000 ± 200. The system obeys Beer's law up to 5 μg of Mo per ml. Cu(II), Fe(III), Ti(IV) and W(VI) interfere; but methods have been developed for the elimination of interference. (auth)

22020 VOLTAMETRIC TITRATION OF METAL IONS WITH EDTA USING A METAL OXIDE ELECTRODE AS INDICATOR. Kainz, G.; Sontag, G. (Univ., Vienna). Mikrochim. Acta; 1: No. 2-3, 171-185(1975). (In German).

The voltametric titration of metal ions by EDTA (according to Kraft) is described. The cathode is of bright platinum. As anode a metal oxide is used. The oxide is deposited out of a metal salt solution before the titration. Following oxides are suitable: Tl_2O_3, Co_2O_3, MnO_2, PbO_2 and PtO_x. The electrodes were polarized by a constant current, which depends on the oxide and varies between 2 and 10 microamperes. The oxide anode indicates an excess of EDTA, whereby the voltage between the electrodes changes rapidly. The height of the change depends strongly on the pH of the solution. For each oxide the optimal polarization current and the range of usage are described. Further the practical use of the oxide electrodes for the determination of various metal ions is shown. (auth)

22021 MASS-SPECTROMETRY OF TRANSITION METAL π-COMPLEXES. Gajvoronskij, P. E.; Larin, N. V. (AN SSSR, Gor'kij. Inst. Khimii). Usp. Khim.; 43: No. 6, 1035-1049(Jun 1974). (In Russian).

For English translation see the journal Russ. Chem. Rev.

Problems of fragmenting transition metal π-complexes by electron collision and the correlations between the basic characterisitics of mass-spectra and metal-ligand binding energies are reviewed. The mass-spectra of these compounds are a good reflection of the nature and binding strength of the metal-ligand, and of structural and other differences. Along with disruption of the metal-ligand bond by electron collision a partial fragmentation takes place in π-ligands bound with the metal atom, the character and degree of fragmentation being determined by the nature and molecular weight of the ligand. Problems dealing with the identification of ions containing atoms of polyisotopic elements, and with the course of ion-molecule reactions in mass-spectrometry are discussed. (tr-INIS)

Radiometric and Radiochemical Procedures

Refer also to abstracts 22063, 22149, 22607, 22707, 22713, 22714, 22798, 23136, and 23504.

22022 DETERMINATION OF THORIUM IN PLUTONIUM BY X-RAY SPECTROMETRY. Woltermann, H. A.; Eckstein, R. R.; Redding, P. L.; Tomes, S. A. (Mound Lab., Miamisburg, Ohio (USA)). J. Nucl. Mater.; 54: No. 1, 117-120(Nov 1974).

An x-ray fluorescence method for the determination of thorium (0.1 to 1.2%) in plutonium-238 was developed. The PuO_2 is mounted in a dimpled slide, and the slide is packaged so that the plutonium and thorium L-alpha lines can be counted in a nonradioactive laboratory. A standard deviation of 0.02% is estimated. The method is applicable to both solid and solution samples. (auth)

22023 PLUTONIUM AND URANIUM DETERMINATION IN ENVIRONMENTAL SAMPLES. Combined Solvent Extraction-Liquid Scintillation Method. McDowell, W. J.; Farrar, D. T.; Billings, M. R. (Oak Ridge National Lab., TN). Talanta; 21: No. 12, 1231-1245(Dec 1974).

A method for the determination of uranium and plutonium by a combined high-resolution liquid scintillation–solvent extraction method is presented. Assuming a sample count equal to background count to be the detection limit, the lower detection limit for these and other alpha-emitting nuclides is 1.0 dpm with a Pyrex sample tube, 0.3 dpm with a quartz sample tube using present detector shielding or 0.02 dpm with pulse-shape discrimination. Alpha-counting efficiency is 100%. With the counting data presented as an alpha-energy spectrum, an energy resolution of 0.2 to 0.3 MeV peak half-width and an energy identification to ± 0.1 MeV are possible. Thus, within these limits, identification and quantitative determination of a specific alpha-emitter, independent of chemical separation, are possible. The separation procedure allows greater than 98% recovery of uranium and plutonium from solution samples containing large amounts of iron and other interfering substances. In most cases uranium, even when present in 10^3-fold molar ratio, may be quantitatively separated from plutonium without loss of the plutonium. Potential applications of this general analytical concept to other alpha-counting problems are noted. Special problems associated with the determination of plutonium in soil and water samples are discussed. Results of tests to determine the pulse-height and energy-resolution characteristics of several scintillators are presented. Construction of the high-resolution liquid scintillation detector is described. (auth)

22024 IMPROVED ELECTROLYSIS PROCEDURE FOR ANALYZING TRITIUM IN ENVIRONMENTAL WATER SAMPLES. Hayes, D. W. (Du Ponte de Nemours (E. I.) and Co., Aiken, SC). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 573-575(Dec 1974).

An analytical procedure was needed to measure the tritium content of surface water samples with tritium ratios in the range 30 to 150 with an error of 15%. The procedure required short counting times and a minimum amount of sample preparation time in order to process large numbers of samples. An electrolysis enrichment procedure, combined with liquid scintillation counting, was selected to achieve the required sensitivity and to minimize analysis time. The procedure, adapted from that given by Osthud and Werner (Tritium in the Physical and Biological Sciences, Vol. I. IAEA Proceedings Series, Vienna (1962)) is described. The enrichment which was required to meet the sensitivity goal is examined. Evaluation of vials for distillation and for counting was made. The aliquot and total sample methods for scintillation counting were compared from which it was found that the best sensitivity (± 7%) was obtained with the total sample method. As a result of investigating the analytical performance of the method the relative precision of the system was found to be ±5 TR. (UK)

22025 ASSAY OF TRITIUM-LABELLED FOLATE IN FECES BY THE OXYGEN FLASK COMBUSTION TECHNIQUE BY LIQUID SCINTILLATION COUNTING. Steytler, J. G. (Northwith Park Hospital, Harrow, Eng.). J. Clin. Pathol.; 27: No. 10, 844-847 (Oct 1974).

A reproducible and relatively sensitive means of measuring tritium activity in tissue and materials such as feces was developed. Prepared dry pellets of tritium-containing feces were ignited in a platinum gauze boat in an atomosphere of oxygen contained in a one litre combustion flask. A liquid scintillator spectrometer was used to count the tritiated water produced. The method was simple in operation and could be applied to the routine assay of large numbers of samples. (UK)

22026 SIMULTANEOUS ALPHA AND BETA PARTICLE ASSAY USING LIQUID SCINTILLATION COUNTING WITH PULSE-SHAPE DISCRIMINATION. McKlveen, J. W.; Johnson, W. R. (Arizona State Univ., Tempe). Health Phys.; 28: No. 1, 5-11 (Jan 1975).

Liquid scintillation, an established technique for low-energy beta-particle detection, is readily adaptable to alpha-particle assay. However, in samples containing mixed radionuclides, the poor fluorescence conversion efficiency for alpha particles may preclude positive identification of the respective particles by energy discrimination. Pulse-shape discrimination methods were used to distinguish the specific type of ionizing radiation by its characteristic light-pulse. The overall detection scheme appears to be suitable for rapid, routine alpha and beta particle radioassay of numerous sample types with activity detection thresholds at normal environmental levels. (auth)

22027 RADIOASSAY OF ^{32}P IN INTACT PLANT ROOTS USING CERENKOV RADIATION DETECTION. Chapin, F. S. III; Holleman, D. F. (Univ. of Alaska, College). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 568-570(Dec 1974).

Experiments designed to investigate the validity of the radioassay method of Lüuchli (Int. J. Appl. Radiat. Isotopes; 20: 265 (1969)), involving the use of Cherenkov radiation as a method of determining ^{32}P concentration in intact plant roots, are reported. Roots of Eriophorum vaginatum L. were used. The effect of root material and the influence of colored substances in the sample on counting efficiency, and the effect of root geometry upon counting variability, were examined. It is concluded that since it was shown that the radioassay of ^{32}P in intact roots gives the same count rate as that determined by the more conventional solution counting of root digests and since root geometry does not affect counting efficiency the more convenient intact root method is recommended for routine assay of ^{32}P in physiological studies. By this method sample preparation time and cost are minimized yet a sensitive and reliable assay of ^{32}P in plant roots is provided. (UK)

22028 LIQUID SCINTILLATION COUNTING AND SAMPLE ADSORPTION. Structural Factors in Organic Molecules Controlling Likelihood of Adsorption. Wigfield, D. C.; Srinivasan, V. (Carleton Univ., Ottawa). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 473-482(Dec 1974).

The adsorption shift method of detecting adsorption (Wigfield and Srinivasan, Int. J. Appl. Radiat. Isotop.; 24: 613 (1973)) has been utilized to examine counting characteristics of 44 specifically labelled ^{14}C-labelled compounds. 11 compounds showed adsorption and 33 were not seriously adsorbed. The relationships between structural features in organic molecules and their likelihood of adsorption to the walls of liquid scintillation counting vials are discussed, and the conclusions summarized. (auth)

22029 USE OF MOESSBAUER SPECTROSCOPY TO INVESTIGATE LUNG SAMPLES CONTAINING IRON. Rush, J. D.; Dickson, D. P. E.; Johnson, C. E.; Hewitt, P. J.; Lam, H. F. (Univ. of Liverpool). Phys. Med. Biol.; 20: No. 1, 128-130 (Jan 1975).

Mössbauer spectroscopy can be used to give information on the chemical form of certain elements, supplementing the elemental data available by neutron activation analysis. Lyophilized samples of lung tissue taken from rats previously exposed to arc weld fume were analyzed for ^{57}Fe, using Mössbauer spectroscopy. Superparamagnetism occurs in samples of iron oxides and hydroxides with small particle sizes, and changes in the Mössbauer spectra with temperature can also be used to indicate the particle sizes present. However, since the Mössbauer data for iron oxides and hydroxides are extremely complex, a comparison was made between the Mössbauer spectra at different temperatures for arc weld fume samples and rat lung samples taken at different times after exposure. The Mössbauer spectra were obtained with sources of ^{57}Co in rhodium, using an absorber of pure iron for calibration. The results were consistent with particles of iron, mainly as Fe_2O_3, of average size around 18 nm in the weld fume, and similar particles of smaller size in the lung samples. (UK)

22030 ANALYSIS OF CARBON-14 LABELED BUTENE–ISOBUTANE ALKYLATION REACTIONS. Handler, L. H.; Smith, E. W. (Sun Oil Co., Marcus Hook, PA). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 521-533(Dec 1974).

A comprehensive scheme was developed for the radiochemical analysis of all reaction and waste products obtained during alkylation of isobutane with butene-1-^{14}C in a stirred batch reactor, using a cerium-exchanged molecular sieve catalyst. As part of this work, methods were developed for the analysis of radioactive gases, liquids, and solids by liquid scintillation counting alone, and by a combined GC-liquid scintillation method. These techniques are generally applicable to the radiochemical analysis of complex tagged reaction mixtures, and are therefore useful for detailed laboratory studies of petroleum processing reactions and mechanistic studies in other related areas. (auth)

22031 EMANATION APPARATUS WITH SIMPLE OPERATIONAL PROCEDURE FOR MEASUREMENT OF LOW LEVELS OF ^{226}Ra. Mastinu, G. G. (CNEN, Casaccia, Italy). Health Phys.; 28: No. 2, 97-100(Feb 1975).

An emanation apparatus with a simple operational procedure for assay of ^{226}Ra in the picocurie range of aqueous samples has been developed. The flush gas is recycled through the sample and a liquid nitrogen cooled trap. About 100% of the radon is retained in the trap from which it is successively released by heating and flushed with helium to a 50-cm^3 α scintillation counter. The counting efficiency of the apparatus is 2.61 ± 0.14 counts/min/pCi radon and the background counting rate 0.08 counts/min. A 1 l sample of water or 10 g amounts (corresponding to kilogram amounts wet weight) of ashed animal or vegetable materials may be analyzed by this procedure. (auth)

22032 DETERMINATION OF IRON IN HIGH-GRADE IRON ORE AND OF LEAD IN LEAD CONCENTRATE BY COMPTON SCATTERING OF 60-keV γ-RAYS FROM AMERICIUM-241. Fookes, R. A.; Gravitis, V. L.; Watt, J. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chem.; 47: No. 3, 589-591(Mar 1975).

Iron in high-grade iron ores (~90% by weight Fe_2O_3) was determined with an absolute rms error of ±0.13% by weight iron for finely ground and dried samples and ±0.9% by weight iron for coarse drill chippings from blast holes. Lead in lead concentrate (~75% by weight Pb) was determined to ±0.56% by weight lead. (auth)

22033 PROMPT ANALYSIS OF BIOLOGICAL SAMPLES BY PROTON BOMBARDMENT. Demortier, G. (Univ., Namur, Belgium). Radiochem. Radioanal. Lett.; 20: No. 3, 197-205(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

Quantitative analysis of C, O, Cl, K, Ca, Mn, Fe, Cu, Zn, Br, Rb and Sr in Bowen's kale and other biological materials has been achieved using prompt atomic and nuclear reactions induced by proton bombardment in the MeV range. Comparison with other techniques are given. (auth)

22034 NEW METHOD FOR THE DETERMINATION OF ^{137}Cs IN ENVIRONMENTAL MATERIALS. Tsai, C. M.; Izawa, G.; Omori, T.; Shiokawa, T. (Tohoku Univ., Sendai). Radiochem. Radioanal. Lett.; 20: No. 3, 167-173(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

An analytical method has been developed for the separation of ^{137}Cs from other radioactive nuclides by precipitation with sodium

tetrakis (p-fluorophenyl) borate. Good decontamination factors and chemical yields have been obtained. The method, following scavenging with ammonium phosphomolybdate, can be applied to environmental samples that contain low concentrations of ^{137}Cs. (auth)

22035 RADIOACTIVE KRYPTONATES OF ORGANOSULFUR COMPOUNDS. VII. Thermal and Dekryptonation Analysis of 2-Naphtylisothiocyanate. Uher, M.; Harangozo, M.; Toelgyesay, J.; Kosik, M.; Jesenak, V. (Slovak Tech. Univ., Bratislava, Czech.). Radiochem. Radioanal. Lett.; 20: No. 3, 221-225(3 Feb 1973).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

The synthesis of radioactive kryptonate of 2-naphthylisothiocyanate by a diffusion technique as well as the thermal (DTA, TG, DTG) and dekryptonation thermal analysis (DkTA) of this kryptonate are described. (auth)

22036 USE OF SPECTROSCOPY OF GAMMA-RADIATION FROM THE INELASTIC SCATTERING OF REACTOR FAST NEUTRONS FOR ELEMENTAL ANALYSIS. Ahmed, M. R.; Demidov, A. M.; Al-Najjar, S. A.; Al-Amili, M. A. (Nuclear Research Inst., Baghdad). J. Radioanal. Chem.; 23: No. 1-2, 199-203(1974).

Gamma-spectra of stainless-steel and soil samples have been measured to study the potentialities of using spectroscopy of γ-radiation from the inelastic scattering of reactor fast neutrons for element analysis of various materials. Contents of iron, chromium, nickel, manganese, silicon and titanium in stainless steel, and those of silicon, iron, aluminium, magnesium, calcium, sodium, titanium, carbon and oxygen in soil have been determined by comparing the spectra of the samples with those of specially prepared mixtures of elements. The distinguishing features, advantages, and limitations of this method are discussed. (auth)

22037 RAPID METHOD OF URANIUM DETERMINATION IN SOLUTIONS BASED ON X-RAY FLUORESCENCE AND ABSORPTION. Kierzek, J.; Parus, J. L. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 24: No. 1, 73-84 (1975).

A method of uranium determination in organic and aqueous solutions was developed, based on fluorescence L x-ray excitation with a ^{109}Cd source of several mCi activity and counting the excited L_α lines with a proportional counter. To eliminate uranium x-ray absorption by the accompanying elements the intensity of the source radiation (Ag K) transmitted through the analysed solution is measured. The ratio of these two intensities is independent of other elements present in the solution over a very broad range of concentration. The analysis time does not exceed 5 minutes. The precision and accuracy of this method in the range 0.5 to 100 g U/l are comparable to those of the classical titrimetric method. (auth)

22038 MICROANALYSIS OF PALLADIUM IN A COPPER MATRIX BY PROTON-INDUCED X-RAY FLUORESCENCE. Demortier, G. (Facultes Universitaires, Namur, Belgium). J. Radioanal. Chem.; 24: No. 1, 47-55(1975).

Quantitative analysis of traces of Pd in a Cu matrix using x-ray fluorescence induced by protons in the MeV range is explained. The method is used for microanalysis of small portions (20 μg) of a sample in which local inhomogeneity of Pd concentration is found. The sensitivity of the technique may reach 5 ppM (quantitative) for one hour of bombardment of metallic samples. This sensitivity of 5 ppM of Pd in 20 μg of material corresponds to 10^{-11}g of Pd effectively detected. The method is rapid (15 min for the determination of 100 ppM of Pd in a Cu matrix with an accuracy of 5%), non-destructive and does not produce any residual activity. Comparative results obtained by other macrotechniques are given. (auth)

22039 DEVELOPMENT AND APPLICATION OF NUCLEAR PHYSICS TECHNIQUES FOR DETERMINING RARE AND NON-FERROUS METALS. Ostroumov, G. V.; Arkhipov, A. A.; Zhuravlev, G. L.; Lyubimov, L. M.; Popova, A. A.; Salmin, Yu. P.; Sergeeva, T. V.; Tokareva, D. V.; Chernova, A. A.; Shiryaeva, M. V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Mineral'nogo Syr'ya, Moscow (USSR)). Izotopy SSSR; No. 32, 10-14(1973). (In Russian).

A review is presented on the studies of VIMS in developing nuclear-physical methods of analyzing rare and nonferrous metals, which were carried out for mineral beneficiation industry associations and which could be applied in geological investigations. (tr-INIS)

Separation Procedures

22040 (PB-234076) REDUCTION OF TETRAVALENT CERIUM AND ITS APPLICATION TO STRIPPING FROM TRI-n-BUTYL PHOSPHATE. Report of Investigations. Schultze, L. E.; Bauer, D. J.; Lindstrom, R. E. (Bureau of Mines, Reno, Nev. (USA). Reno Metallurgy Research Center). Jun 1974. 13p. (BM-RI-7906). NTIS $3.00.

Bench-scale studies were conducted to develop techniques for stripping tetravalent cerium from tri-n-butyl phosphate solutions. Experiments were conducted in a constant temperature bath using beakers and mechanical stirring. Ninety-five percent of the cerium was stripped from a 50% tri-n-butyl phosphate 50% kerosine solution containing 0.18 M cerium in 15 minutes at 50°C using 0.11 M aqueous formaldehyde. (GRA)

22041 COMPARISON OF FERROCYANIDES FOR CESIUM EXTRACTION. Hendrickson, W. F.; Riel, G. K. (Naval Ordnance Lab., Silver Spring, MD). Health Phys.; 28: No. 1, 17-21(Jan 1975).

A study was made of ferrocyanide containing materials that are used for extraction of cesium from sea water, environmental and biological samples, and reactor fuel reprocessing waste. A compilation was made of distribution coefficient, capacity, and selectivity with respect to Cs/K. A comparison is made between granular ferrocyanides and other extractants prepared by precipitation of a ferrocyanide on a substrate of glass fibers or macroreticular materials. (auth)

22042 EXAMINATION OF A RARE EARTH SOLVENT-EXTRACTION CIRCUIT FOR POSSIBLE UPGRADING OF THE YTTRIUM PRODUCT. Lucas, B. H.; Ritcey, G. M. (Dept. of Energy, Mines and Resources, Ottawa). CIM (Can. Mining Met.) Bull.; 68: No. 753, 124-130(Jan 1975).

In Canada, rare earths have been recovered from ion-exchange barren solutions after uranium recovery. The rare earths, in one circuit, are extracted into di(2-ethylhexyl)phosporic acid using a centrifugal contactor, and recovered as a bulk rare earth concentrate. Parameters were investigated with the object of producing an upgraded rare earth product. This paper shows that, by variation of the flow ratios, pH, solvent concentration and modifier, the yttrium grade in the product can be raised from 30% to 60%. Results are also shown to indicate possibilities for group rare earth separations. (auth)

22043 EXTRACTION OF ACTINIDES FROM NITRIC ACID SOLUTIONS BY NEUTRAL BIFUNCTIONAL ORGANOPHOSPHORUS COMPOUNDS. Myasoedov, B. F.; Medved, T. Ya.; Nemodruk, A. A.; Nesterova, N. P.; Koiro, O. E.; Kabachnik, A. M. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Chem. (Engl. Transl.); 217: No. 4-6, 558-561(Aug 1974).

Translated from Dokl. Akad. Nauk SSSR; 217: No. 5, 1087-1090 (Aug 1974).

Results from the study of extraction of U(VI), Pa(V), Pu(IV), and Am(III) by cis- and trans-bis(diphenylphosphinyl)ethylene, bis(diphenylphosphinyl)acetylene, and bis(diphenylphosphinyl) ethane from nitric acid solutions established that cis-bis(diphenylphosphinyl)ethylene extracts U(VI) and Pu(IV) significantly better than it does Pa(V) and Am(III). It was shown that the extraction power of cis-bis(diphenylphosphinyl)ethylene is higher than that of the other dioxides studied. (auth)

22044 EFFECT OF HYDROGEN ION CONCENTRATION ON THE ANODIC DEPOSITION OF ^{212}Pb. Madi, I. (Kossuth Lajos Univ., Debrecen, Hungary). Radiochem. Radioanal. Lett.; 20: No. 3, 207-214(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

The kinetics of the anodic deposition of ^{212}Pb was investigated at a given anode voltage as a function of the hydrogen ion concentration of the solution to be electrolyzed. A linear relationship between the pH of the solution and the logarithm of the equilibrium distribution coefficient was found for the deposition of the ^{212}Pb on the surface of the platinum anode. (auth)

22045 THE BREAKTHROUGH BEHAVIOUR OF ION EXCHANGERS. Dincler, G.; Bobleter, O. (Innsbruck Univ. (Austria). Inst. fuer Physikalische Chemie; Atominstitut der Oesterreichischen Hochschulen, Vienna). Z. Phys. Chem. (Frankfurt); 86: No. 3-6, 156-169(Oct 1973). (In German).

9 refs.; 4 refs.; 2 tabs.

Cation exchangers of Type Dowex 50X12 (H^+ form) were loaded with approximately 10^{-2} molar solutions of strontium and cesium nitrate containing 0.01 to 0.5 molar nitric acid. The concentration of the effluent solution was determined by measuring the activity (^{90}Sr and ^{137}Cs). The logarithm of the concentration is proportional over a wide range to the volume of the effluent. A formula was derived for the linear region of these logarithmic breakthrough curves by using the given parameters of the exchanger column and the solution. Further, it was shown that the diffusion to the exchanger particle is the determining factor, when the distribution coefficients are high. The thickness of the diffusion layer is a function dependent on

time. In the case of lower distribution coefficients, an increase in the slope of the breakthrough curves occurs, due to the back diffusion of the ions. An empirical formula was found, which takes this influence into account. (auth)

22046 EXTRACTION OF URANIUM(IV) WITH DIHEXYL ESTER OF PHENYLSULFONYLAMIDOPHOSPHORIC ACID. Shevchenko, F. D.; Malysheva, A. N.; Kuzina, L. A. (Kiev State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 7, 970-972(1974). (In Russian).

Extractive properties of the uranium (IV) complex with dihexyl ester of phenylsulfonylamidophosphoric acid (I) have been obtained; the complex has a composition UO_2A_2 where A is the anion of (I). The stability constants of the uranium (IV) complexes with (I) were determined by the method of graphic differentiation; they are: $1g\beta_1 = 6.00$ and $1g\beta_2 = 11.32$; the complex distribution constant $1gP_2 = 3.08$, the extraction constant $1gK_{ex} = 1.49 \pm 0.03$. (JPRS)

22047 CHROMATOGRAPHIC SEPARATION OF RARE-EARTHS BY CATION EXCHANGE. Dependence of Lanthanide Peak Position on Eluant pH. Karol, P. (Carnegie-Mellon Univ., Pittsburgh). J. Radioanal. Chem.; 24: No. 1, 17-19 (1975).

A simple relationship expressing the dependence of elution peak position shifts on change in eluant pH is developed for rare-earth ion-exchange separations using α-hydroxyisobutyric, α-hydroxy α-methyl butyric and lactic acids as eluants. (auth)

22048 INTERACTION UNDER NON-EQUILIBRIUM CONDITIONS OF ALUMINUM WITH SALT MELTS CONTAINING URANIUM. Zolotarev, A. B.; Kashcheev, I. N.; Novoselov, G. P. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 835-836(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 195(Sep 1973). This is a summary of paper No. 691/7273 with full copy held at TIC.

The interaction of aluminum with UF_4-LiF and UF_4-NaF salt mixtures was studied for an initial uranium concentration of 15% by weight and a temperature of 1150°C under non-equilibrium conditions. It was found that the extraction of uranium from a UF_4-LiF mixture increases continuously as the holding time is increased, becoming almost 100% for an experiment lasting 150 min. Uranium extraction in the UF_4-NaF system reaches a maximum within 15 min and thereafter decreases. (LK)

22049 APPLICATION OF HIGH VOLTAGE ELECTROPHORESIS FOR THE SEPARATION OF RADIONUCLIDES. VII. Separation of Radioactive Fission Products. Buchtela, K. (Oesterreichische Hochschule, Vienna). Mikrochim. Acta; 1: No. 2-3, 289-303(1975). (In German).

Mixtures of radioactive fission products are rapidly separated by high voltage electrophoresis. Solutions of α-hydroxyisobutyric acid and acetylcellulose carriers are used. Components of an artificial mixture of fission products, a process solution from a fuel reprocessing plant, and neutron-irradiated uranium and plutonium are separated. The electropherograms are measured by scanning, autoradiography, and liquid scintillation counting. (auth)

22050 SORPTION OF URANYL IONS BY THE CATION EXCHANGER KAAF-0.40. Alovitdinov, A. B.; Kochkarova, Kh. Y.; Kuchkarov, A. B. (Tashkent Polytechnic Inst.). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 915-916(Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1555-1556(Jun 1974).

The sorption of uranyl ions from organic and inorganic acid solutions and from buffer solutions by the KAAF-0.40 cation exchanger was investigated. A high affinity of the uranyl ion for this exchanger has been observed. (auth)

22051 SOLVENT EXTRACTION OF TECHNETIUM(VII) BY 4-(5-NONYL)PYRIDINE AND ITS SEPARATION FROM URANIUM AND SOME FISSION PRODUCTS. Iqbal, M.; Ejaz, M. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). J. Radioanal. Chem.; 23: No. 1-2, 51-62(1974).

The extraction of technetium (VII) by 4-(5-nonyl)pyridine was investigated from different aqueous solutions. Separation from uranium and some fission products was achieved in nitrate media. From the results of partition experiments, attempts were made to deduce the nature of the extracted species. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 22021, 22126, 23226, 23300, 23405, and 23820.

22052 (AGC-1999(Vol.6)) ANALYTICAL AND PRELIMINARY DESIGN STUDIES OF NUCLEAR ROCKET PROPULSION SYSTEMS. Volume VI. Compilation of Hydrogen Properties. Barney, J. D.; Magee, P. M. (Aerojet-General Corp., Azusa, Calif. (USA)). Jun 1961. 58p. Dep. NTIS $6.00.

This volume presents a graphic compilation of the physical, thermodynamic, and transport properties of molecular hydrogen, including the effects of variations in the ratio of concentrations of orthohydrogen and parahydrogen. It provides a single source of correlated data in engineering units for the design of fluid systems utilizing hydrogen. (auth)

22053 (ORNL-TM-4744) IODINE BEHAVIOR IN AN HTGR. Compere, E. L.; Osborne, M. F.; de Nordwall, H. J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 52p. Dep. NTIS $5.45.

The emission of iodine from nuclear power reactors as a result of normal operations or postulated accidents is regulated by requiring exclusion area boundaries such that the dose to any individual outside the area will be less than stipulated values. Application of the "as low as practicable" limit, proposed for light-water-cooled nuclear power reactor effluents, to the activity released from a typical reactor installation (here an HTGR), indicates that the release of ^{131}I should be as much below 13 mCi/year as is practicable using today's technology. Estimated values of primary coolant leak rate, and of the decontamination factor during passage through PCRV cracks and secondary containment, lead to a derived limit on the amount of iodine in the primary coolant gas. A consideration of the rates of removal from the primary coolant by purification and by deposition (plateout) on system surfaces, and of entry rates from failed coated particle fuel, indicates that some surface deposition is desirable. The metal surfaces of the system are expected to be oxidized. Permanent adsorption on Fe_3O_4 may be insufficient to sustain the needed deposition for the lifetime of the reactor, according to the experimental data presented. However, if iodine atoms exchange rapidly between gas and surface phases, the surface requirement is smaller and appears to be met. Formation and decomposition of volatile metal iodides around the circuit are possible, but concentrations may be too low for direct deposition to occur. In the case of postulated accidents, the iodine that is retained as deposits on primary system surfaces represents a major source of released iodine. It does not appear likely that regulatory limits would be exceeded by any accidents, provided prompt isolation of the secondary containment occurs. Even in the lack of such isolation, complete depressurization in the absence of an appreciable temperature rise in the steam generators should not cause doses at the exclusion area boundary due to release of surface-sorbed iodine to exceed limits stated in the Code of Federal Regulations, Title 10, Part 100. (auth)

22054 THERMALLY INDUCED REACTIONS OF IMIDAZOLE DERIVATIVES. P. 5. Thermal Rearrangements of 2,4,4-Triaryl-5-Methylthio-4H-Imidazoles. A Crossing Experiment. Koltai, E.; Nyitrai, J.; Lempert, K. (Budapesti Muszaki Egyetem (Hungary). Inst. fuer Organische Chemie); Bursics, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Chem. Ber.; 107: No. 5, 1649-1653(May 1974). (In German).

By means of a crossing experiment, the 1,2 aryl shift in the course of the thermal rearrangement of 2,4,4-triaryl-5-methylthio-4H-imidazoles into 2,4,5-triarylimidazoles was demonstrated with the help of a ^{14}C-labelled compound to proceed intramolecularly. (GE)

22055 THE FIRST IONIZATION POTENTIALS OF NEPTUNIUM AND NEPTUNIUM MONOXIDE. Rauh, E.G.; Ackermann, R.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 62: No. 4, 1584-1584 (15 Feb 1975).

The ionization potentials of Np(g) and NpO(g) were determined by electron impact utilizing mass-spectrometric measurements of vapor phase isomolecular equilibria. The results gave good agreement with surface ionization and spectroscopic data. (AIP)

22056 STUDIES ON METALLIC AZIDES. VI. Stability of the Azide Complexes of Praseodymium. El-Atrash, A. M.; El-Shamy, H. K.; Abdel-Aziz, I. E. (Univ. of Kuwait). J. Radioanal. Chem.; 23: No. 1-2, 83-88(1974).

The stability constant for the formation of $Pr(N_3)^{2+}$ was measured by using solid cation-exchange resin (Dowex-50), and found to be 1.26 ± 0.12 at 22 ± 2 °C and $\mu = 2.0M$. Radioactive ^{142}Pr was used as a tracer. (auth)

22057 SEARCH FOR NEW RADIOPROTECTIVE AGENTS. Pt. 25. Synthesis of Some Sulphides of 2-Quinoxaline Derivatives. Tulecki, J.; Kalinowska-Torz, J.; Powalska, J. (Akademia Medyczna, Poznan (Poland)). Ann. Pharm. (Poznan); 10: 13-16(1973). (In Polish).

By condensation of 2-chloroquinoxaline with β-tionaphthole, β-naphthloaminoacetylo-mercaptane and p-chlorotiophenol, the following compounds, not described in the available literature, were obtained: 2-(β-naphthlotio)-quinoxaline, 2-(β-naphthloaminoacetylotio)-quinoxaline, 2-(p-chlorophenylotio)-quinoxaline. The compounds were identified by elementary analysis and assayed biologically. (auth)

22058 SEARCH FOR NEW RADIOPROTECTIVE AGENTS. Pt. 24. Synthesis of Some Sulphenamides, Derived from Phenotiazine. Tulecki, J.; Osinska, Z. (Akademia Medyczna, Poznan (Poland)). Ann. Pharm. (Poznan); 10: 9-12(1973). (In Polish).

By coupling phenotiazine with 2-, 3-, 4-nitrophenylosulphenylochlorides, the following sulfenamides, undescribed in the available literature, were obtained: 10/2'-nitrophenylotio/-phenotiazine, 10/3'-nitrophenylotio/-phenotiazine, 10/4'-nitrophenylotio/-phenotiazine. (auth)

22059 SEARCH FOR NEW RADIOPROTECTIVE AGENTS. Pt. 23. Synthesis of Some Sulphur Derivatives of 5-Nitroindole. Tulecki, J.; Skwarski, D.; Spychala, R. (Akademia Medyczna, Poznan (Poland)). Ann. Pharm. (Poznan); 10: 3-7(1973). (In Polish).

By coupling of 5-nitroindole with 2-, 4-nitro- and 2,4-dinitrophenylosulphenylo-chlorides, the following sulfur derivatives of 5-nitroindole undescribed in the available literature were obtained: N-/2'-nitrophenylo-tio-/5-nitroindole, N-/4'-nitrophenylo-tio-/5-nitroindole, N-/2',4'-dinitrophenylo-tio-/5-nitroindole. The compounds were identified by elementary analysis and ir spectroscopy. (auth)

Isotope Effects

Refer also to abstract 23316.

22060 ISOTOPE EFFECTS MEASURED BY MOESSBAUER SPECTROMETRY IN FERROUS OXALATE AND PERCHLORATE. Brunot, B. (Koeln Univ. (F. R. Germany). 1 Physikalisches Inst.). Chem. Phys. Lett.; 29: No. 3, 368-370(1 Dec 1974).

The influence of the substitution of H by D was investigated by means of the Moessbauer effect in the compounds $FeC_2O_4 \cdot 2H_2O$ and $Fe(ClO_4)_2 \cdot 6H_2O$. Isomer shifts δ and quadrupole splittings ϵ were measured between 90 and 300°K. An important isotope effect dependent on temperature was observed for the value of ϵ in oxalate. Only a slight difference for the value of δ could be determined in perchlorate. The well-known transition of the perchlorate takes place at temperatures that differ by 4°K for the deuterated and hydrogenated compounds. (auth)

22061 MOESSBAUER STUDY OF ISOTOPE EFFECTS AND PHASE TRANSITION OF FERROUS TETRAFLUOROBORATE HEXAHYDRATE. Brunot, B. (Koeln Univ. (F. R. Germany). 1 Physikalisches Inst.). Chem. Phys. Lett.; 29: No. 3, 371-375 (1 Dec 1974).

The isomer shift δ and the quadrupole splitting ϵ were measured for the compounds $Fe(BF_4)_2 \cdot 6H_2O$ and $Fe(BF_4)_2 \cdot 6D_2O$. A phase transition analogous to that of the perchlorate was observed. The transition temperatures T_t are higher than those of the perchlorate: T_t = 272 K (cooling down) and T_t = 279 K (rewarming) for $Fe(BF_4)_2 \cdot 6H_2O$. The values of both δ and ϵ are sensitive to the deuteration. The experimental results are qualitatively explained with due consideration for nature of the hydrogen bonds present in the studied compounds. (auth)

22062 ENERGY GAP LAW IN THE SOLVENT ISOTOPE EFFECT ON RADIATIONLESS TRANSITIONS OF RARE EARTH IONS. Stein, G.; Wuerzberg, E. (Hebrew Univ., Jerusalem). J. Chem. Phys.; 62: No. 1, 208-213(1 Jan 1975).

Data on the fluorescent yields of tervalent ions of Pr, Sm, Eu, Gd, Tb, Dy, and Tm in H_2O and D_2O, containing perchlorate ions, and isotope effects on the fluorescence are reported. The results are interpreted in terms of the mechanisms responsible for radiationless processes in solutions of rare earth ions [Y. Haas and G. Stein, J. Phys. Chem. 75: 3668 (1971); 76: 1093 (1972)]. It is shown that along the series of the closely related rare earth ions, all of which exhibit well shielded f-f electronic transitions, the results can be correlated in terms of a single variable: the energy gap between the lowest fluorescent and highest nonfluorescent level. For several rare earth ions, the matching of this gap by a single high energy (OH or OD) vibration of one solvent molecule is the decisive factor accounting for observed yields and isotope ratios. (auth)

22063 DETERMINATION OF KINETIC HYDROGEN ISOTOPE EFFECT BY MEANS OF RADIOGAS CHROMATOGRAPHY. Simon, L. P.; Horvath, L.; Marton, J. (Izotop Intezete, Budapest). Izotoptechnika; 17: No. 12, 594-600(Dec 1974). (In Hungarian).

Non-reacted and initial benzene activity in the positive halogenation benzene was determined using tritium gas chromatographic separation, and activity measurement with liquid scintillation techniques. (auth)

22064 DEUTERIUM KINETIC ISOTOPE EFFECTS IN β-ELIMINATION FROM PHENETHYL BROMIDE PROMOTED BY PARA-SUBSTITUTED SODIUM PHENOXIDES IN DIMETHYLFORMAMIDE. Alunni, S.; Baciocchi, E.; Mancini, V. (Univ., Perugia, Italy). J. Chem. Soc., Perkin Trans., II; No. 15, 1866-1869(1974).

Deuterium kinetic isotope effects have been measured for elimination from phenethyl bromide promoted by para-substituted sodium phenoxides in dimethylformamide. Despite the large basicity range considered variations in the magnitude (in the range 7.6 to 9.0) of the isotope effects were practically within experimental error. Some evidence for proton tunnelling was obtained and this has made difficult a straightforward interpretation of the k_2^H/k_2^D values in terms of transition state geometry. (auth)

22065 ELIMINATIONS PROMOTED BY WEAK BASES. VI. Isotope, Basicity, and Substituent Effects on the Dehydrochlorination of 1,1-diaryl-2,2,2-Trichloroethanes in Dimethylformamide. McLennan, D. J.; Wong, R. J. (Univ. of Auckland, New Zealand). J. Chem. Soc., Perkin Trans., II; No. 15, 1818-1822(1974).

Primary hydrogen isotope effects on the rates of the dehydrochlorination reactions of $Ar_2CH{\cdot}CCl_3$ with the bases Cl^-, Br^-, $p\text{-}NO_2C_6H_4S^-$, and $2,4\text{-}(NO_2)_2C_6H_3O^-$ in dimethylformamide are reported. The values of k_H/k_D are in the range 5.1 to 5.6 and are largely independent of ring substituents in the substrate and of the base employed. It is considered that they are too high to admit the possibility of an E2C mechanism, and an E2H explanation is favoured. Brønsted correlations of log k_2 vs. pK_a are not linear. The effect of ring substituents on the equilibrium constants for the reversible dehydrochlorinations promoted by Bu_4^tNCl in acetone is negligible, which indicates that the transition states are not olefin-like, but rather have an excess of negative charge on C_β. (auth)

22066 RECENT ADVANCES IN THE STUDY OF KINETIC HYDROGEN ISOTOPE EFFECTS. Bell, R. P. (Univ. of Stirling, Eng.). Chem. Soc. Rev.; 3: No. 4, 513-544(1974).

From Liversidge lecture; London, Eng. (1 Nov 1973).

The review considers how far the available experimental material on primary kinetic hydrogen isotope effects, especially in solution, can be accounted for by a theoretical treatment. Particular attention is given to reactions of the type XH + $Y \xrightarrow{k^H}$ X + HY; XD + $Y \xrightarrow{k^D}$ X + DY (and the corresponding reaction involving tritium), where X and Y are either atoms or groups, and the primary isotope effect is defined as the ratio k^H/k^D. No reference is made to the qualitative or semiquantitative use of isotope effects in elucidating the broad outlines of reaction mechanisms, or to secondary or solvent isotope effects. (UK)

22067 THERMODYNAMIC STUDY OF THE DEUTERIUM ISOTOPE EFFECT, THE MOLAR EXCESS ENTHALPIES OF C_6D_6 + c-C_6H_{12} AND OF C_6H_6 + c-C_6H_{12}. Mattingly, B. I. (Univ. of Otago, Dunedin, N. Z.); Fenby, D. V. Aust. J. Chem.; 28: No. 1, 185-187(Jan 1975).

Molar excess enthalpies of C_6D_6 + c-C_6H_{12} and of C_6H_6 + c-C_6H_{12} have been measured at 298.15°K; the equimolar values are 818.7 and 797.0 J mol^{-1} respectively. (auth)

22068 β-DEUTERIUM ISOTOPE EFFECTS FOR THE SOLVOLYSIS OF 2-METHYL-d_3-exo-2-NORBORNYL p-NITROBENZOATE AND 2-METHYL-d_3-endo-2-NORBORNYL p-NITROBENZOATE. Muller, R. J.; Winternitz, C.; Murr, B. L. (Johns Hopkins Univ., Baltimore). J. Org. Chem.; 40: No. 4, 412-414 (21 Feb 1975).

Kinetic isotope effects for the solvolysis of 2-methyl-d_3-exo-2-norbornyl p-nitrobenzoate and 2-methyl-d_3-endo-2-norbornyl p-nitrobenzoate were determined in 70% aqueous ethanol. Within experimental error, k_H/k_D for both epimers are similar—exo p-nitrobenzoate (1.22 ± 0.02 at 75.0°), endo p-nitrobenzoate (1.26 ± 0.04 at 130.0°; 1.31 ± 0.05 corrected to 75.0°)—where k_H/k_D is calculated for three deuteriums for fully deuterated substrate. The similarity of the kinetic isotope effects for the exo and endo epimers argues against the supposition of extensive bridging in the intermediate for the solvolysis of the exo p-nitrobenzoate. These results are in good agreement with kinetic isotope effect measurements for other deuterated tertiary norbornyl substrates already in the literature. (auth)

22069 UNUSUALLY LARGE DEUTERIUM ISOTOPE EFFECT IN THE ACID-CATALYZED CIS–TRANS ISOMERIZATION OF A

DIENE–IRON TRICARBONYL COMPLEX. Whitesides, T. H.; Neilan, J. P. (Univ. of Wisconsin, Madison). J. Amer. Chem. Soc.; 97: No. 4, 907-908(19 Feb 1975).

The authors report that trifluoroacetic acid catalyses the cis to trans isomerization of η^4-(1,5-diphenylpentadiene-1,3)tricarbonyl iron, that the catalysis involves rate-determining protonation at the metal atom, and that this protonation occurs with an unusually large isotope effect of about 27. (LK)

22070 INVERSE KINETIC ISOTOPE EFFECT IN THE REDUCTION OF HINDERED KETONES BY LiAl(OBu-t)$_3$H AND LiAl(OBu-t)$_3$D. Wigfield, D. C. (Carleton Univ., Ottawa); Phelps, D. J.; Pottie, R. F.; Sander, R. J. Amer. Chem. Soc.; 97: No. 4, 897-898(19 Feb 1975).

Kinetic isotope effects were measured by competition experiments, the two reducing agents competing for ketone, followed by mass spectral determination of the H/D ratio of alcohol. The primary isotope effect for reduction of most ketones ranged from unity to 1.5. (LK)

22071 NITROGEN ISOTOPE EFFECTS IN THE HYDROLYSIS OF BENZENEDIAZONIUM SALTS. Swain, C. G.; Sheats, J. E.; Harbison, K. G. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Chem. Soc.; 97: No. 4, 796-800(19 Feb 1975).

The α-nitrogen kinetic isotope effect k_{14}/k_{15}, in dediazoniation of 0.1 M benzenediazonium (I) fluoborate in 1% H_2SO_4 solution at 25° is 1.0384 ± 0.0010, as deduced from the β-nitrogen isotope effect of 1.0106 ± 0.0003 for I-β-^{15}N BF_4^- and the overall nitrogen isotope effect of 1.0245 ± 0.0005 for normal I. Use of an independent method of analysis for the nitrogens in benzenediazonium ion confirms the conclusion of Lewis, Insole, and Holliday that its rearrangement is a minor reaction (1.6% relative to dediazoniation) under these conditions. These isotope effects strongly indicate rate-determining formation of phenyl cation. (auth)

22072 AROMATIC HYDROGEN ISOTOPE EFFECTS IN REACTIONS OF BENZENEDIAZONIUM SALTS. Swain, C. G.; Sheats, J. E.; Gorenstein, D. G.; Harbison, K. G. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Chem. Soc.; 97: No. 4, 791-795(19 Feb 1975).

Kinetic secondary deuterium isotope effects, k_H/k_D, are 1.22 ± 0.01 for each ortho position, 1.08 ± 0.01 for each meta position, and 1.02 for the para position in dediazoniations of benzenediazonium fluoborate in aqueous H_2SO_4, CH_3CO_2H, or CH_2Cl_2 solutions at 25°. These ortho effects are the largest secondary aromatic hydrogen isotope effects yet observed, are comparable in magnitude to those observed for β deuterium in tertiary aliphatic ester solvolyses, and strongly indicate rate-determining formation of phenyl cation. A vibrational analysis of benzenediazonium ion indicates that the isotope effect cannot arise solely from relief of strain on the ortho hydrogens but may result from diminishing of the force constants of all the vibrations of the C–H bonds in the ortho, meta, and para positions by 10, 4, and 1%, respectively. This is attributed to substantial hyperconjugative delocalization of positive charge onto ortho and meta hydrogens in the transition state. The slightly lower isotope effect of 1.48 ± 0.02 for 3,5-dimethylbenzenediazonium-2,4,6-d_3 vs. 1.52 ± 0.02 for benzenediazonium-2,4,6-d_3 confirms that hyperconjugation rather than relief of strain is the source of the kinetic isotope effect. Molecular orbital calculations by the INDO method predict the ground state of phenyl cation to be a singlet, essentially linear at C_1, with positive charge partially distributed throughout the molecule, especially at the ortho hydrogens. (auth)

22073 EVIDENCE FOR PHENYL CATION AS AN INTERMEDIATE IN REACTIONS OF BENZENEDIAZONIUM SALTS IN SOLUTION. Swain, C. G.; Sheats, J. E.; Harbison, K. G. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Chem. Soc.; 97: No. 4, 783-790(19 Feb 1975).

Displacements on benzenediazonium cation, $C_6H_5N_2^+$, in solution in the absence of strong bases, reducing agents, or light proceed by rate-determining cleavage to a singlet phenyl cation intermediate, $C_6H_5^+$, rather than by the bimolecular mechanism proposed in 1969. In aqueous solution at 25°, only unrearranged products are obtained, and negligible incorporation of deuterium from solvent D_2O occurs, showing that aryne processes do not occur to a significant extent. The low selectivity between nucleophiles nevertheless requires a highly reactive intermediate. In the hydrolysis of $C_6H_5N_2^+$, the high entropy of activation (+10.5 cal mol^{-1} deg^{-1}) and the constancy of k_1 (within 4%) from H_2O to D_2O demonstrate that water is not involved as a nucleophile in the rate-determining step. The constancy of k_1 (within 10%) in solutions as diverse as 14–21 M H_2SO_4 and 100% CH_3CO_2H and CH_2Cl_2 is in accord with a common rate-determining step over this whole range of solvents. Para-substituent effects can be dissected into nearly equal field (predominantly transition state) and resonance (predominantly reactant) contributions by an analysis using dual substituent constants (previously published), with a correlation coefficient of 0.992, although analysis using the Hammett $\rho\sigma$ equation, i.e., with only a single set of substituent constants, yields a correlation coefficient worse than zero. (auth)

22074 INFRARED SPECTRA OF DITHIOOXAMIDE AND ITS COMPLEXES. Ray, A.; Sathyanarayana, D. N. (Indian Inst. of Science, Bangalore, India). Indian J. Chem.; 12: No. 10, 1092-1095(Oct 1974).

Infrared spectra of dithiooxamide (DTO) and its deuterated analogue (DTO-d_4) have been assigned using normal coordinate treatments. Monomeric complexes of DTO with Ni(II) and Co(II) chlorides, and polymeric complexes with Ni(II) and Cu(II) have been prepared and their infrared spectra assigned on the basis of the results obtained for DTO. (auth)

22075 RAMAN AND INFRARED SPECTRA OF Hf(BH$_4$)$_4$ AND Hf(BD$_4$)$_4$. Evidence for Hf–B Bonding. Keiderling, T. A. Princeton Univ., NJ); Wozniak, W. T.; Gay, R. S.; Jurkowitz, D.; Bernstein, E. R.; Lippard, S. J.; Spiro, T. G. Inorg. Chem.; 14: No. 3, 576-579(Mar 1975).

Raman and infrared spectra are reported for Hf(BH$_4$)$_4$ and Hf(BD$_4$)$_4$. A normal-coordinate analysis gave reasonable valence force constants and accurate A_1 eigenvectors. The latter were used, in conjunction with measured Raman intensities, to calculate bond polarizabilities and estimate bond orders. A striking feature of the Raman spectrum is a strong polarized Raman band near 500 cm^{-1}, assignable to a HfB$_4$ breathing mode. Analysis of the bond polarizability derivative of this coordinate suggests that Hf–B bonding may be significant in Hf(BH$_4$)$_4$. (auth)

22076 TEMPERATURE-DEPENDENT SPLITTING CONSTANTS IN THE ELECTRON SPIN RESONANCE SPECTRA OF CATION RADICALS. V. CH Protons in Some Tetrasubstituted Benzenes. Sullivan, P. D.; Brette, N. A. (Ohio Univ., Athens). J. Phys. Chem.; 79: No. 5, 474-479(27 Feb 1975).

Measurements of the temperature coefficients of the CH protons in a series of 1,2,4,5-tetrasubstituted benzene cation radicals are reported. The compounds studied fall into two groups depending on the sign of the CH temperature coefficient. A representative compound from each group, 1,2,4,5-tetramethoxybenzene and 1,4-dimethoxy-2,5-dimethylbenzene, was studied in detail in order to evaluate the $\alpha^H_{CH}/\alpha^D_{CD}$ ratios. Qualitative observations on line width asymmetries are also reported. The results are interpreted in terms of theories previously proposed for temperature coefficients and line width asymmetries to show that when the sign of a CH proton splitting is positive one observes a positive temperature coefficient, $\alpha^H_{CH}/\alpha^D_H > 6.514$ and low-field broadened lines, or when the sign of the splitting is negative one observes negative temperature coefficients, $\alpha^H_{CH}/\alpha^D_{CD} < 6.514$ and high-field broadened lines. (auth)

22077 INTRAMOLECULAR FORCES IN THE WATER MOLECULE IN LITHIUM SULFATE MONOHYDRATE. Hayward, H.P.; Schiffer, J. (Department of Chemistry, Temple University, Philadelphia, Pennsylvania 19122). J. Chem. Phys. 62: No. 4, 1473-1479 (15 Feb 1975).

A study of the low–temperature infrared spectra of varyingly deuterated mulls of lithium sulfate monohydrate has afforded information on the origin of bands due to the vibrations of the water molecule in the solid. Assignments are made for the intermolecularly uncoupled modes which produce these bands in the spectrum and intramolecular coupling force constants are calculated. (auth)

22078 ABSTRACTION VERSUS EXCHANGE IN THE REACTION OF H WITH DBr. Su, H.Y. (Department of Chemistry, The University of Texas at Austin, Austin, Texas 78712); White, J.M.; Raff, L.M.; Thompson, D.L. J. Chem. Phys. 62: No. 4, 1435-1443 (15 Feb 1975).

The photolysis of DBr–H_2–Br_2 mixtures at 185 nm furnishes data which can be analyzed to provide the abstraction to exchange rate coefficient ratio k_a/k_b for reactive collisions of H with DBr where H is a translationally hot atom with an average energy of about 1 eV. The results of such experiments are reported here and are analyzed using (1) an assumed mechanism, (2) available independent experimental data, (3) some quasiclassical trajectory data, and (4) an isotope effect model based on collision frequencies to give $0.2 \leqslant k_a/k_b \leqslant 0.8$. In addition quasiclassical trajectory calculations have been used to generate model data for direct comparison with the experimental data. These calculations, using potential energy surfaces which have been very successful in accounting for a variety of other experimental data, give $k_a/k_b = 0.24$, as well as values for the other rate coefficients in the mechanism. With a single adjustable parameter used to fit the intercept in one experiment, these trajectory calculations are in quite satisfactory agreement with the experimental data provided D–atom exchange with DBr is incorporated as a significant mechanism for thermalization of hot D atoms. It is also shown that the photolysis data are consistent

with trajectory calculations that give an abstraction to exchange ratio for thermal H atoms that lies in the range 0.2–1.0. (auth)

22079 DYNAMICS OF MOLECULAR REORIENTATIONAL MOTION AND VIBRATIONAL RELAXATION IN LIQUIDS. CHLOROFORM. Rothschild, W.G. (Scientific Research Staff, Ford Motor Company, Dearborn, Michigan 48121); Rosasco, G.J.; Livingston, R.C. J. Chem. Phys. 62: No. 4, 1253-1268 (15 Feb 1975).

Vibrational and rotational (dipole and second–order tensor) correlation functions were obtained by Fourier inversion of infrared and Raman vibrational band contours of the three || and one ⊥ fundamental of liquid $CHCl_3$, $CDCl_3$, and isotopically pure $CH^{35}Cl_3$. All correlation functions are nonexponential at short times and approximately exponential for long times. The symmetry axis of the molecule reorients by "free" jumps of about 1/3 rad, turning through a root–mean–square angle of 1 radian within 2psec by about 13 orientational jumps. Computer simulations show that *J* diffusion is too fast beyond 1 psec and that *M* diffusion fits the data up to 4 psec (τ_J = 0.12 psec); thereafter, *M* diffusion is too slow. The Raman rotational correlation time is approximately equal to the NMR quadrupolar correlation time; the infrared rotational correlation time is only 0.75 of a corresponding dielectric relaxation time. Vibrational relaxation in the symmetric near–infrared carbon–hydrogen stretch is of the same order of importance as rotational relaxation; however, the dynamics of the vibrational relaxation of this mode do not support the presence of "hydrogen bonding" in the neat liquid. In the symmetric far–infrared carbon–chlorine deformation mode, vibrational relaxation is of considerably lesser significance than rotational relaxation throughout the whole time domain, whereas the rate of vibrational relaxation of the symmetric midinfrared carbon–chlorine stretch is intermediate to those of the other two symmetric fundamentals. None of these modes obeys vibrational energy dissipation or resonance vibrational energy transfer mechanism induced by dipole–dipole interaction. The ratios of the derived polarizability tensor elements, which are required to evaluate the rotational correlation function of the degenerate mode (carbon–hydrogen deformation), were computed from formulations relating them to the bond polarizabilities: It appears that its Raman and infrared correlation function does not contain the same vibrational correlation function and that the respective contour is determined essentially by nonorientational relaxation processes. An extensive analysis of the experimental errors inherent in our Raman band contour determinations is presented, as well as a critical comparison of our conclusions with previous results in the literature. (auth)

22080 CARBON–CARBON BOND LENGTHS IN CYCLOPROPYLAMINE. Harmony, M.D.; Bostrom, R.E.; Hendricksen, D.K. (Department of Chemistry, University of Kansas, Lawrence, Kansas 66045). J. Chem. Phys. 62: No. 4, 1599-1600 (15 Feb 1975).

The natural abundance microwave spectra for the 1–^{13}C and 2–^{13}C species of cyclopropylamine were obtained and the rotational constants calculated. By combining these data with previously obtained rotational constants for the normal species, the C–C bond lengths were obtained. Comparison of these results with bond lengths for other saturated cyclopropyl compounds does not suggest a clear pattern for various substituents. (AIP)

22081 CHARACTERISTICS OF THE KINETIC ISOTOPE EFFECT IN THE DEGRADATION OF ORGANIC MACROMOLECULES. Galimov, E. M. (Moscow Inst. of the Petrochemical and Gas Industry). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 811-814(Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1381-1385(Jun 1974).

It has been established experimentally that the kinetic isotope effect in the degradation of organic macromolecules (the humification of an organic substance) is unduly low. It is suggested that this is because such processes are characterized by a fairly broad band of activation energies. Examination of the multilayer model of the decomposition process corresponding to this case shows that the degree of fractionation of isotopes within the framework of this model is significantly lower than in the single-layer model corresponding to the decomposition of simple organic compounds. The reduction of the kinetic isotope effect depends on the width of the activation energy band. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 22114.

22082 (CEA-R-4652) DIPHENYLMETHYALKALI COMPOUNDS SOLUTIONS IN DIPHENYLMETHANE: ISOTOPIC EXCHANGE WITH HYDROGEN. Spectroscopic Study. Baffert-Forges, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Chimie). Feb 1975. 55p. (In French). Dep. NTIS (US Sales Only) $5.75.

The isotopic exchange between hydrogen and diphenylmethane catalyzed by diphenylmethylcesium was studied between 120 and 180°C. The results are similar to those obtained with diphenylmethylpotassium: the values of the activation energy and entropy are respectively $Ea^* = 21 \pm 1$ kcal · mole^{-1} and $\Delta S^*_{180} = 1.5 \pm 2$ eu; the exchange reaction is first order with respect to hydrogen and catalyst concentration. The spectroscopic study of diphenylmethyllithium, -potassium, and -cesium has been made between 350 and 600 nm. The absorption spectrum is a temperature independent single peak, the absorption maximum being respectively at 429, 446, and 449 nm for diphenylmethyllithium, -potassium, and cesium. A linear relationship is observed between the wave number of the absorption maximum and the inverse of the alkali ion ionic radius. So diphenylmethylalkali compounds form only contact ion pairs in diphenylmethane solution, and the catalytic species of the isotopic exchange between hydrogen and diphenylmethane are the contact ion pairs $(C_6H_5)_2\,CH^{\ominus\oplus}M$, where $M^{\oplus}$ is the alkali ion. So, the kinetic equation of the exchange may be written: $v = k_0[H_2][(C_6H_5)_2\,CH^{\ominus\oplus}M]$. The proposed associative reaction mechanism involves a linear activation complex formed by a diphenylmethane molecule, a hydrogen molecule, and a contact ion pair diphenylmethylcesium or -potassium. (auth)

22083 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. XXVI. Catalysis of Tritium Exchange Between Benzene and Solvent Water by Potassium Tetrachloroplatinate(II). Blackett, L.; Gold, V.; Rueben, D. M. E. (King's Coll., London). J. Chem. Soc., Perkin Trans., II; No. 15, 1869-1873(1974).

Tritium uptake by benzene, dissolved in acidified tritiated water containing chloride ions at 50°, is catalyzed by tetrachloroplatinate(II) ions. The first-order exchange rate constant λ is approximately proportional to the concentrations of catalyst and hydrogen ion and inversely proportional to the concentration of chloride ions. The reaction mechanism required by these reaction orders involves at least one (and probably two) low-concentration intermediates of the composition $(C_6H_6\text{-}PtCl_3)^-$ and (at low acid concentrations) the rate-limiting protonation of such an intermediate. Possible structures of the various reaction intermediates are indicated. (auth)

22084 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. XXVII. Catalysis of Aromatic Tritium Exchange Between Benzyl Alcohol and Solvent Water by Potassium Tetrachloroplatinate(II). Gold, V.; Gould, S. E.; Reuben, D. M. E. (King's Coll., London). J. Chem. Soc., Perkin Trans., II; No. 15, 1873-1879(1974).

Tritium uptake into the aromatic positions of benzyl alcohol from tritiated solvent water (containing some acid and chloride ions, at 50°) is catalyzed by tetrachloroplatinate(II). The reaction shows a somewhat erratic induction period [due to platinum(IV) impurity] which is greatly increased by addition of potassium hexachloroplatinate(IV). Almost no exchange occurs during the induction period, so that for several days the reaction appears to be totally suppressed by Pt^{IV}. The results are interpreted in terms of the rate-limiting formation of a common intermediate (an adduct between benzyl alcohol and $PtCl_3^-$) which is oxidized by Pt^{IV} more rapidly than it can proceed to exchange hydrogen with the solvent. The rate of the exchange reaction (after the induction period) is approximately proportional to the concentration of $PtCl_3^-$ and inversely proportional to the concentration of chloride ion. The dependence of the exchange rate on hydrogen-ion concentration is consistent with a protolytic equilibrium involving the alcohol group in a benzyl alcohol-$PtCl_3^-$ complex ($pK \geq 3.6$), with the basic form being more reactive than its conjugate acid. (auth)

22085 STABLE ISOTOPE MASS FRAGMENTOGRAPHY: IDENTIFICATION AND HYDROGEN–DEUTERIUM EXCHANGE STUDIES OF EIGHT MURCHISON METEORITE AMINO ACIDS. Pereira, W. E. (Stanford Univ., CA); Summons, R. E.; Rindfleisch, T. C.; Duffield, A. M.; Zeitman, B.; Lawless, J. G. Geochim. Cosmochim. Acta; 39: No. 2, 163-172(Feb 1975).

The concentration of eight protein amino acids found in extracts of the Murchison carbonaceous chondrite has been measured by quadrupole mass fragmentography. This result was obtained by using deuterated amino acids as internal standards. In addition, hydrogen-deuterium exchange in amino acids was studied by two methods. First, nondeuterated amino acids were added to the meteorite and the amount of deuterium incorporated after extraction with deuterium oxide was determined. Second, deuterated amino acids were added to the dry meteorite and the loss of deuterium after extraction with H_2O was measured. It was observed that the degree of hydrogen-deuterium exchange increased with increasing severity of extraction conditions. This exchange resulted in some racemization, presumably catalyzed by constituents of the meteorite. The degree of racemization for each amino acid was determined by gas chromatography of the corresponding N-trifluoroacetyl-0- (+)-2-butyl esters. (auth)

22086 MECHANISM FOR THE SEPARATION OF ISOTOPES OF WATER AND GASES IN HYDRATE FORMATION ZONES OF THE EARTH'S CRUST. Trofimuk, A. A.; Cherskii, N. V.; Tsarev, V. P. Dokl. Akad. Nauk SSSR; 215: No. 5, 1226-1229(11 Apr 1974). (In Russian).

The characteristics of the fractionation of H, O, N, S, C, and He, which are present and concentrated in the upper part of the earth's crust and in the boundary zone of the hydrosphere are studied. The previous determination that the heavy isotopes of these elements are concentrated in hydrates (and in the case of ^{4}He by its capture by the hydrates of other gases) was confirmed by new measurements of isotopic ratios. The differentiation of the isotopes of natural gases and waters in the hydrate formation zones exists on a planetary scale but its mechanism and the effect of this process are unknown. (JSR)

22087 ISOTOPIC EXCHANGE REACTIONS BETWEEN 2,4-DINITROBENZYL CHLORIDE AND CHLORIDE IONS IN MIXED SOLVENTS. El-Atrash, A. M.; El-Shetary, B. A. (Ain Shams Univ., Cairo). Indian J. Chem.; 12: No. 10, 1080-1082(Oct 1974).

The rates of exchange between 2,4-dinitrobenzyl chloride (OrgCl) and sodium chloride (NaCl) in the mixed solvents 90% ethanol–10% water and 80% dioxane–20% water by weight are represented respectively by the rate laws: $R = 8.56 \times 10^8 \exp(-19280/RT)[OrgCl]\ \alpha\ [NaCl]$ and $R = 1.02 \times 10^9 \exp(-19140/RT)[OrgCl]\ \alpha\ [NaCl]$ where α is the degree of dissociation of the salt in the solvent used and units of R are mole litre^{-1} sec^{-1}. The reactions, studied at 20°, 35° and 50°C, are found to be of S_N2 type, in conformity with the earlier findings. (auth)

22088 FERROELECTRIC EFFECT IN THE CATALYTIC REACTIONS OVER A $BaTiO_3$ SURFACE AT ITS CURIE POINT (120°C). Kawai, T.; Kunimoki, K.; Kondow, T.; Onishi, T.; Tamaru, K. (Tokyo Univ. (Japan). Dept. of Chemistry). Z. Phys. Chem. (Frankfurt); 86: No. 3-6, 268-273(Oct 1973).

4 figs.; 2 refs.

The activation energies for catalytic CO oxidation and the N_2O reduction by carbon monoxide over a typical ferroelectric substance, $BaTiO_3$, changed at its Curie point (120°C). This activation energy change, on the other hand, was not appreciable in the H_2–D_2 exchange reaction over the same catalyst. These observations were interpreted in terms of the molecular structures of the intermediate species, the change in the surface electronic properties of the $BaTiO_3$ at the Curie point, and the different interactions between dipole-dipole and dipole-nondipole. (auth)

22089 ISOTOPIC EXCHANGE AND DIFFUSIVITY OF HYDROGEN IN THE HYDROGEN–AMINOMETHANE SYSTEM. Kalra, H. Edmonton, Alberta; Univ. of Alberta (1973). 231p. Thesis.

Mass transfer studies with a single sphere absorber were used to determine the diffusivity of hydrogen in liquid aminomethane over a temperature range of −20°C to −30°C. The diffusion coefficients were found to lie in the range of 90×10^{-6} to 110×10^{-6} cm^2/sec. A modified Ferrell and Himmelblau correlation has been derived from the diffusion data for hydrogen in ammonia and in aminomethane. It is recommended for use in estimating the diffusion coefficients for hydrogen, hydrogen deuteride, and deuterium in aliphatic amines where experimental data are not available. The accuracy of the diffusion data obtained is estimated to be within ±5%. Pseudo-first order reaction rate constants for the liquid phase hydrogen deuteride aminomethane exchange were determined over the temperature range of −10°C to −30°C. This was achieved by measuring the rates of absorption of hydrogen deuteride into a thin film of liquid aminomethane flowing over a sphere absorber operating in the fast reaction regime. Potassium methyl amide in solution with aminomethane was used to catalyze the exchange process. Rate constants were found to be in the range of 230 to 570 sec^{-1} at catalyst concentrations ranging up to 15.8 (g K/kg amine). The rate constant appears to vary linearly with catalyst concentration up to a value of 5.0 (g K/kg amine). The activation energy of the reaction was estimated to be 3.1 (kcal/g mole). An expression was derived which represents the data in the range of investigation to ±4% and is recommended for predicting the rate constants at conditions of temperature and catalyst concentration where data are not available. It is estimated that the accuracy of the rate constants obtained is within ±10%. (auth)

22090 STUDIES ON THE C–H/C–D EXCHANGE IN IMIDAZOLIUM (PILOCARPINIUM) AND IN 2- AND 4-HYDROXIMINOMETHYL PYRIDINIUM COMPOUNDS. Ben-Bassat, A. A.; Lavie, D. (Weizmann Inst. of Science, Rehovot, Israel). Israel J. Chem.; 12: No. 4, 845-856(1974).

The H–D exchange of methylene protons in a side-chain when situated between a positively charged ($\alpha-CH_2$) and a ketone function was studied in various pilocarpinium (N-methyl imidazolium) and hydroximinomethyl pyridiniums using NMR measurements. Structural factors which determine the course of the exchange are reported, and the role of the solvent was examined. Mass-spectra of nondeuteriated and deuteriated 4-hydroximinomethyl-1-phenacyl-pyridinium chloride confirmed the fast exchange of the $\alpha-CH_2$. An alternative H–D exchange of the C_2–H in the imidazolium moiety of certain pilocarpinium compounds without a ketone in the N-chain was detected. Mechanisms for the two types of exchanges involving an ylid as intermediate and attack of a deuteron were proposed. (auth)

22091 INVESTIGATIONS OF HYDROGEN–DEUTERIUM EXCHANGE IN α-CHYMOTRYPSIN. Kania, L.; Siemion, I. Z. (Wroclaw Univ. (Poland)). Acta Biochim. Pol.; 20: 15-23(1973).

H-D exchange in α-chymotrypsin at pD 4.6, in the temperature range 9 to 40°C, was investigated. On this basis the activation energy, and the values of enthalpy and entropy of activation were obtained. These data led to the conclusion that local segmental conformational motions are responsible for the observed rate of exchange. Addition of salt ($CaCl_2$, $MgCl_2$, and NaCl) had only slight influence on the rate of exchange. (auth)

22092 MEASUREMENTS OF THE CALCIUM ISOTOPE SEPARATION FACTOR IN THE AMALGAM–WATER SYSTEM. Klinskii, G. D.; Knyazev, D. A. (Moscow Inst. of Chemical Engineering). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 890-891(Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1518-1519(Jun 1974).

The calcium isotope separation factor in the amalgam-water system was measured by the method of multistage removal. The mass-spectrometric measurements of the isotope effects were made in the last three removal stages using a furnace source. The separation factor has been calculated as $\alpha^{44}_{40} = 1.00955 \pm 0.00062$. This exceeds somewhat the available literature values both in magnitude and accuracy. (auth)

22093 SEPARATION OF OXYGEN ISOTOPES BY CONTINUOUS ADSORPTION. Sarukhanov, A. V.; Kochurikhin, V. E.; Magomedbekov, E. P.; Zel'venskii, Ya. D. (Moscow Inst. of Chemical Engineering). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 885-886(Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1512-1513(Jun 1974).

The single-stage separation factors for oxygen isotopes in adsorption on a synthetic NaX zeolite were measured in the pressure range 25 to 160 torr at 78°K. The separation of oxygen isotopes by continuous countercurrent adsorption has been investigated on the NaX zeolite at 78°K. The variation of the degree of separation and the height equivalent to the theoretical stage with gas pressure in the column and with the flow rate of the adsorbent is presented. (auth)

Radiation Chemistry

Refer also to abstracts 22762, 22905, 22906, 22914, and 23407.

22094 (AD-785934) RADIOLYSIS OF AMMONIUM PERCHLORATE ON EXPOSURE TO X RAYS. Nevostruev, V. A.; Zakharov, Yu. A.; Anikeeva, V. V. Translated from Izv. Tomsk. Politekh. Inst.; 199: 80-83(1969). 7p. (FSTC-HT-23-1101-73). NTIS $3.25.

In the radiolysis of NH_4ClO_4 on exposure to 0.18-MeV x-rays, the primary radiolysis product of ClO_4^- is the ClO_3^- ion. The radiation-chemical yields for the radiolysis products are reported. (GRA)

22095 (AD-785971) USE OF A CYCLOTRON TO STUDY THE RADIATION CHEMISTRY OF SOLIDS. Oblivantsev, A. N.; Lykhin, V. M.; Eremin, L. P. Translated from Izv. Tomsk. Politekh. Inst.; 176: 116-121(1970). 9p. (FSTC-HT-23-913-73). NTIS $3.25.

During the last five years, work has been performed using the cyclotron of the Scientific Research Institute of Nuclear Physics at the TPI, to study the radiochemical stability of ionized crystals under the action of a proton beam escaping into the atmosphere. Azides, nitrates, perchlorates, and permanganates of alkali metals were used as targets. (GRA)

22096 (AD-786021) NUMERICAL CALCULATION OF UV EMISSION AND ABSORPTION SPECTRA OF OH. Final Report, 1 March 1972–1 March 1973. Neer, M. E. (Technology, Inc., Dayton, Ohio (USA)). Aug 1974. Contract F33615-71-C-1463. 147p. (ARL-74-0109). NTIS $5.75.

The report presents the details and uses of a computer program designed to predict the ultraviolet emission and absorption

spectra of OH associated with combustor flowfields. The intended purpose of the computer program is to facilitate the development of spectroscopic diagnostic techniques for specific application to supersonic mixing and combustion. The mathematical models used to represent the emitting and absorbing gas are given. Geometry and apparatus considerations are discussed, as well as calibration procedures. The computation scheme is outlined including the basic modes of operation, and the manner in which input data are submitted is explained. The various uses of the computer program are demonstrated and comparisons are made with experimental spectra. Two graphical inversion techniques are also presented, one of which can be used to obtain radial profiles of temperature and OH number density from an axisymmetric combustor flowfield. A listing of the computer program and a partial printout are included. (GRA)

22097 (AD-787294) DISSOCIATION OF CH_4 BY ELECTRON IMPACT: PRODUCTION OF METASTABLE HYDROGEN AND CARBON FRAGMENTS. Finn, T. G.; Carnahan, E. L.; Zipf, E. C. (Pittsburgh Univ., Pa. (USA). Space Research Coordination Center). Aug 1974. 33p. (SRCC-209). NTIS $3.75.

Metastable fragments produced by electron impact excitation of CH_4 have been investigated for incident electron energies from threshold to 300 eV. Only metastable hydrogen and carbon atoms were observed. Most of the fragments appear to have been formed in high-lying Rydberg states. The total metastable hydrogen and carbon cross sections are reported. (auth)

22098 (AED-CONF-74-465-000) DISCUSSION MEETING "RADIATION CHEMISTRY OF POLYMERS". Book of Abstracts. (Gesellschaft Deutscher Chemiker, Frankfurt am Main (F. R. Germany). Fachgruppe Kern-, Radio- und Strahlenchemie; Gesellschaft Deutscher Chemiker, Frankfurt am Main (F. R. Germany). Fachgruppe Makromolekulare Chemie). 1974. 48p. (In German, English). INIS.

From Discussion meeting "radiation chemistry of polymers"; Garching/Muenchen, F. R. Germany (23 Oct 1974).

Available from ZAED.

Abstracts of lectures held at the discussion meeting concerning the radiation chemistry of polymers are presented. Main topics are free radical decay in irradiated polyethylene, gamma irradiations of polymers, pulse radiolysis studies, oxidative degradation of polystyrene and polytetrahydrofuran, radiation induced oxidations, crosslinking of polyethylene, weathering tests of wood-plastics, resistance of plastics to ionizing radiations, electron beam irradiations, and graftings. (GE)

22099 (COO-1385-65) ELECTRON SPIN RESONANCE STUDIES OF RADIATION EFFECTS. Annual Progress Report, January 1, 1974–December 31, 1974. Rogers, M. T. (Michigan State Univ., East Lansing (USA)). 1974. Contract AT(11-1)-1385. 15p. Dep. NTIS $4.00.

This project is primarily devoted to a study of the effects of high-energy radiation, particularly γ rays, on nonmetallic solids. Electron spin resonance spectroscopy (ESR) has been used to identify paramagnetic species produced, study their molecular and electronic structures, and follow their reactions and decay. Fundamental processes in the radiation chemistry of solid organic and inorganic compounds were studied by ESR. The effects of radiation depend strongly on the chemical constitution of the solid and a wide variety of materials have been examined to identify the more stable paramagnetic products and search for general principles governing radiation damage. Structure and bonding in radical products were deduced from the ESR parameters. (auth)

22100 (LBL-3180) MEASUREMENT OF RADIATION DAMAGE IN ORGANIC MATERIALS IN THE RANGE OF ELECTRON ENERGY BETWEEN 200 keV and 650 keV. Howitt, D. G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 56p. Dep. NTIS $6.00.

Thesis.

Radiosensitivities of l-valine and adenosine to electron irradiation at energies in the range from 200 keV to 650 keV were studied. The radiosensitivities were standardized according to the loss of crystallinity of the material, which was monitored from it's diffracting properties, after techniques were devised so as to measure the electron doses. From the results obtained, conclusions can be drawn as to the applicability of high voltage transmission electron microscopy techniques to the detailed study of these materials and to the general behavior of organic solids. The results indicate that the radiosensitivities of these materials are decreased by approximately 50 percent over this total energy range. (auth)

22101 PROCESS FOR RADIATION CROSS-LINKING POLYMETHYL ACRYLATE-METHYL ACRYLATE COMPOSITIONS. Kagiya, T.; Mitsui, H.; Tsuneta, K.; Mihara, H. (to Ube Industries, Ltd.). US Patent 3,857,768. 31 Dec 1974. Priority date 28 Oct 1969, Japan. 10p.

A monomer, necessarily containing methyl acrylate, is dissolved in or swelled with polymethyl acrylate to produce resin compositions that are capable of readily cross-linking under irradiation of ionizing radiation or ultraviolet rays. They are useful for making, among others, coatings, adhesives, and resin formers. (Official Gazette)

22102 EFFECT OF ACID ON THE RADIATION-INDUCED GRAFTING OF MONOMERS TO POLYOLEFINS. Garnett, J. L.; Yen, N. T. (Univ. of New South Wales, Kensington, Australia). J. Polym. Sci., Polym. Lett. Ed.; 12: No. 4, 225-229(Apr 1974).

Using styrene in methanol as a representative monomer system, grafting to polypropylene shows an acid effect over the monomer concentration range from 20 to 60%. The corresponding data for polyethylene demonstrate an acid effect over all concentration ranges. The polyethylene data also illustrate an interesting dose-rate dependence of the acid effect. As the dose rate is increased from 40 to 500 krad 1 hr, the presence of acid markedly accelerates the grafting. The order of the effect of acids is HNO_3 > H_2SO_4 > $HClO_4$. (LK)

22103 RADIATION CROSS-LINKING OF POLYETHYLENE IN THE PRESENCE OF ACRYLIC ACID. Singer, K.; Joshi, M.; Silverman, J. (Univ. of Maryland, College Park). J. Polym. Sci., Polym. Lett. Ed.; 12: No. 7, 387-390(Jul 1974).

Low-density polyethylene films of different thicknesses were gamma irradiated in the presence of acrylic acid in varying concentrations in degassed water or benzene solutions. The gamma dose rates used varied between 39 and 600 krad/hr. The preliminary experimental data support the mechanism which attributes the apparent enhanced cross-linking during the irradiation to a high degree of intermolecular hydrogen bonding in the grafted film and by the subsequent formation of covalent anhydride bonds during conventional gel determinations. (LK)

22104 MODULATION EFFECTS IN THE STIMULATED ELECTRON SPIN ECHO OF FREE RADICALS. Yudanov, V. F.; Soldatov, V. P.; Tsvetkov, Yu. D. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). J. Struct. Chem. (USSR) (Engl. Transl.); 15: No. 4, 510-515(1974).

Translated from Zh. Strukt. Khim.; 15: No. 4, 600-606(1974).

Modulation effects in stimulated electron spin echo were studied for $CH_3(CH_2)_2COOH$ free radicals stabilized in an irradiated glutaric acid monocrystal at 77°K. An expression was obtained describing stimulated echo decay for the case of hyperfine interactions with one spin $I = 1/2$ nucleus. A study of the orientation dependence of modulation effects makes possible a determination of the hfi tensor in a situation where this is difficult to do using the stationary ESR method. (auth)

22105 EFFECT OF TEMPERATURE ON RECOMBINATION LUMINESCENCE AND ELECTRON TUNNELLING. Ershov, B. G. (Inst. of Chemical Physics, Moscow); Kieffer, F. Nature (London); 252: No. 5479, 118-119(8 Nov 1974).

It was found that the recombination luminescence that occurs in alkaline glass after γ-irradiation at 77°K decreased in intensity when the glass was cooled, and between 60°K and 4°K the activation energy was probably about zero. This is considered to be direct evidence of a tunnelling mechanism, involving a long-range electron transfer, and which is general in glassy materials. An experimental study is described the object of which was to study the temperature effect on the recombination kinetics of glassy materials, using the isothermal luminescence technique (ITL), in the range 77 to 4°K. NaOH glass containing phenol was used, the phenol increasing the ITL intensity. Irradiation was conducted with a ^{60}Co source at a dose rate of 5kR/min for periods of 5 to 15 min. The intensity of ITL after irradiation at 4°K was found to be about five times larger than after irradiation at 77°K. (UK)

22106 RADIATION DAMAGE IN L-HISTIDINE · HCl MONOHYDRATE. Saxeboel, G.; Sagstuen, E. (Univ. of Oslo). Int. J. Radiat. Biol.; 26: No. 4, 373-382(Oct 1974).

The radiation-induced radicals in L-histidine · HCl monohydrate were studied with ESR spectroscopy. In the temperature region 170 to 185°K, an intermediate radical was formed with the unpaired electron located in a π-orbital on the α-carbon atom, interacting with one α- and two β-protons. The principal values for the α-proton coupling were −11.1, −19.4 and −31.8 gauss. The isotropic splitting constants for the β-protons were 44.3 and 7.0 gauss. The g-value was almost isotropic around 2.0036. The intermediate radical is proposed formed by a deamination process. The formation of the radical was described by first-order kinetics. The activation energy for the process was calculated to 15.9 kcal/mole. (auth)

22107 SIGNIFICANCE OF HYDROGEN BONDING IN ELECTRON SOLVATION PROCESSES IN ETHANOL–N–HEXANE

LIQUID MIXTURES. Brown, B. J. (Macquarie Univ., North Ryde, Australia); Barker, N. T.; Sangster, D. F. Aust. J. Chem.; 27: No. 12, 2529-2534(Dec 1974).

Infrared spectrometry has been used to identify the quasi-stable associated alcohol complexes significant to electron solvation processes when ethanol-n-hexane liquid mixtures are subjected to high energy ionizing radiation. The solvated free electron yield is directly related to the square of the concentration of alcohol unimer species. This result has been interpreted in terms of the electron being solvated primarily by alcohol dimer. (auth)

22108 ELECTRON SPIN RESONANCE AND CNDO/2 STUDY OF THE RADICALS PRODUCED DURING FAST ELECTRON IRRADIATION OF SUBSTANCES CONTAINING NITROGEN. III. Piperidine. Helcke, G. A.; Fantechi, R. (Commission of the European Communities, Ispra). J. Chem. Soc., Faraday Trans., II; 70: No. 12, 1912-1919(1974).

The fast-electron irradiation of piperidine in a matrix of adamantane, thiourea or molecular sieve results in the formation of only one identifiable radical species, piperidin-2-yl. The most stable conformer of this radical is the boat form but, except at low temperatures, it undergoes rapid inversion which exchanges the axial and equatorial hydrogens of the methylene groups adjacent to the N atom and the radical C atom. The inversion gives rise to a distinct alternating line width effect for each methylene group, from which activation energies of 35.5 ± 5 kJ mol^{-1} and 22 ± 5 kJ mol^{-1} can be derived for the processes. CNDO/2 calculations predict hyperfine splittings for the boat form in very good agreement with those observed. (auth)

22109 RADICALS IN IRRADIATED MONOCRYSTALS OF THE BASE PAIR COMPLEX 9-ETHYL ADENINE: 1-METHYL URACIL. Flossmann, W.; Mueller, A.; Westhof, E. (Univ., Regensburg, Ger.). Int. J. Radiat. Biol.; 26: No. 5, 481-492(Nov 1974).

Radical formation in monocrystals of equimolar complexes of 9-ethyl adenine : 1-methyl uracil by irradiation with x-rays was investigated at 77 and 300°K using e.s.r.-spectroscopy at 9.5 GHz and 35 GHz. Five different types of spectrum were identified, which corresponded to spectra of the irradiated components. A hydrogen abstraction radical (I and III) and a hydrogen addition radical (II and IV) were assigned to each of the two constituents. The fifth species, with an unidentified singlet after irradiation at 77°K, has also been found in irradiated single crystals of 9-ethyl adenine. By bleaching with UV-light or heating to about 150°K, it was decomposed irreversibly. After a crystal irradiated at 77°K was warmed to room temperature only pyrimidine radicals I and II were left. At 77°K the two types of radicals (I and II) in 1-methyl uracil were present in addition to the singlet line; at 300°K the addition radicals (II and IV) predominated in comparable proportions, but the abstraction radicals (I and III) were present only in small concentrations. Since the latter were more abundant in the single components we concluded that hydrogen addition was facilitated in the complex. (auth)

22110 CONVERSION OF PARA TO ORTHOHYDROGEN IN A GAMMA-RAY AND NEUTRON RADIATION FIELD. Conant, J. W. (Los Alamos Scientific Lab., NM); Edeskuty, F. J.; Huston, J. E.; Thome, F. V. Cryogenics; 15: No. 1, 12-16(Jan 1975).

The radiation-induced conversion of para to orthohydrogen was investigated at pressures between 1 to 15×10^6 Pa at three temperatures: 77°K (LN_2), 200°K (dry ice), and 300°K (ambient). The radiation dose levels were studied: gamma rays only at 8×10^6 rads and a combination of 5×10^{12} n mm^{-2}, E > 1 MeV, plus gamma rays at 8×10^5 rads. The conversion at LN_2 temperature was nearly zero in all cases. (auth)

22111 APPLICATION OF TIME-DEPENDENT RATE CONSTANT THEORY TO REACTIONS OF SOLVATED ELECTRONS. Reaction Distances, Rate Constants, and Diffusion Coefficients in Concentrated Aqueous Solutions. Buxton, G. V.; Cattell, F. C. R.; Dainton, F. S. (Univ. of Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 115-122(1975).

The rates of reaction of e_{aq}^- with a number of solutes were measured in the temperature range 190 to 260°K in concentrated aqueous solutions of LiCl and NaOH + KOH. The rate coefficients are observed to be time-dependent and fit the equations developed by Noyes (Progr. Reaction Kinetics; 1:129 (1961)). Using these equations estimates have been obtained of diffusion-controlled rate constants, reaction distances, and diffusion coefficients for each reaction. These suggest that e_{aq}^- reacts, and may also diffuse, by a tunnelling mechanism. The temperature dependences of the rate constants and diffusion coefficients are similar to those of other transport processes in glass-forming solutions. (auth)

22112 RADIATION FIXATION OF DYES ON NATURAL SILK. Tikhomolova, M. P.; Ledneva, V. A.; Stepantsova, N. P.; Geller, B. E. (Tashkent Inst. of the Textile and Light Industries). J. Appl. Chem. USSR (Engl. Transl.); 47: No. 8, 1871-1874(Aug 1974). Translated from Zh. Prikl. Khim.; 47: No. 8, 1826-1830(Aug 1974).

Radiation fixation of dyes belonging to various classes on natural silk was studied. Specimens were immersed in an aqueous solution of the dye studied and irradiated with γ rays from ^{60}Co. Color changes of the dyes after radiation fixation, the high fastness of the dyeings to wet treatments, and the occurrence of a "protective effect" suggest formation of covalent bonds between natural silk and the dyes. (LK)

22113 GAS PHASE KINETIC STUDY OF RELATIVE RATES OF REACTION OF SELECTED AROMATIC COMPOUNDS WITH HYDROXYL RADICALS IN AN ENVIRONMENTAL CHAMBER. Doyle, G. J.; Lloyd, A. C.; Darnall, K. R.; Winer, A. M.; Pitts, J. N. Jr. (Univ. of California, Riverside). Environ. Sci. Technol.; 9: No. 3, 237-241(Mar 1975).

A 6000-liter environmental chamber has been used to determine the relative rates of disappearance of eight aromatic compounds in air under simulated atmospheric conditions of temperature, pressure, concentrations, light intensity, and other trace contaminants (NO_x, CO, hydrocarbons, water). Evidence is presented to support the hypothesis that, in the early stages of reaction under these conditions, the OH radical is the species largely responsible for the chemical transformation of the aromatics (as well as other relatively unreactive hydrocarbons such as n-butane). Under this assumption and using published rate constants for the reaction OH + n-butane, rate constants are calculated for reaction of OH with toluene, p-, m-, and o-xylene, 1,2,3-, 1,2,4-, and 1,3,5-trimethylbenzene with values (at 304 ± 1°K) ranging from $(2.5 \pm 0.9) \times 10^9$ l. mol^{-1} sec^{-1} for toluene to $(3.1 \pm 0.4) \times 10^{10}$ l. mol^{-1} sec^{-1} for 1,3,5-trimethylbenzene. An upper limit of 2.3×10^9 l. mol^{-1} sec^{-1} was determined for benzene. The rate constants for reaction of OH with m-xylene and the trimethylbenzenes are at least as large as that for OH + propylene, confirming that substituted aromatics may play a significant role in atmospheric chemistry. (auth)

22114 RADIATION-INDUCED SULFUR EXCHANGE BETWEEN CARBON DISULFIDE AND ELEMENTAL SULFUR. Johnston, F. (Univ. of Georgia, Athens). J. Phys. Chem.; 79: No. 5, 419-421 (27 Feb 1975).

When CS_2 solutions containing elemental sulfur labeled with ^{35}S absorbs ionizing radiation, sulfur exchange between the two species is observed. The tracer also becomes incorporated in a polymer formed in the radiolysis. The G value for the exchange increases linearly with sulfur concentration above 0.01 g-atom l^{-1} and is 0.23 sulfur atoms exchanged per 100 eV of absorbed energy at 0.06 g-atoms l^{-1} of elemental sulfur. The data indicate that the exchange is partially a spur reaction with an additional contribution from reactions of the CS molecule with elemental sulfur. (auth)

22115 KINETICS OF THE RADIATION INDUCED DECOMPOSITION OF SODIUM NITRATE. Frances, A. College Park, MD; Univ. of Maryland (1974). 258p. University Microfilms Order No. 75-4951.

Thesis (Ph.D.).

It has been observed that the concentration of total reducing species (nitrite included) formed in the radiolytic decomposition of sodium nitrate (and other nitrates) is always greater than the amount of nitrite produced. It has been determined that this difference is due to a color center (presumably O_2^-) tightly bound to an intermediate complex. The rate of the radiolytic decomposition of sodium nitrate has been found to be extremely dependent upon the concentration of nitrite in the sodium nitrate lattice up to a concentration of about 0.2 μmole NO_2^-/g $NaNO_3$, after which the rate of decomposition approaches a steady state value. This is explained by the simultaneous occurrence of two reaction paths in the decomposition of sodium nitrate. One of these paths involves the decomposition via excitation or ionization to yield nitrite ion and oxygen and is proportional to absorbed dose. The other reaction path involves decomposition of the nitrate ion by an energy transfer mechanism. This path also yields NO_2^- and O_2, the rate of which decreases with increasing concentration of the nitrite ion. This effect appears to persist up to a nitrite concentration of about 0.2 μmole NO_2^-/g $NaNO_3$. It was further observed that $NaNO_3$ decomposition exhibits an unusual temperature dependence with $G(NO_2^-)$, having a minimum value at about 0°C. It was found that a phase transition occurs in the sodium nitrate lattice between −5 and −30°C which adequately explains this unusual temperature dependence of the decomposition. (Diss. Abstr. Int., B)

22116 RESONANCE STUDIES ON x-IRRADIATED L-HISTIDINE HNO_3. Rustgi, S.N.; Box, H.C. (Department of Physics and Astronomy, State University of New York at Buffalo, Buffalo, New York 14214). J. Chem. Phys. 62: No. 4, 1592-1593 (15 Feb 1975).

The paramagnetic species NO_3^{2-} and NO_2 are detected using ESR in single crystals of L-histidine HNO_3 x irradiated at a temperature of 4.2°K. (AIP)

22117 RADIATION EFFECTS ON NAD. P. 2. Nicotinic Acid, Nicotinamide and nicotinamide mononucleotide. Schachinger, L.; Heindl, B. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/Muenchen (F. R. Germany)). Atomkernenergie; 24: No. 2, 121-128(1974). (In German).

Nicotinamide mononucleotide (NMN) and nicotinamide form the functional part of the nicotinamide-adenine dinucleotide molecule, while the adenine part enhances the activity. It was therefore of particular interest to examine the effect of irradiation on this molecule. Through analysis of the dose-effect curves it was found, contrary to previous views, that the pyridine ring is very sensitive to irradiation. The primary induced radiation changes consist in the attachment of radicals, which results in a stable hydroxylation rather than the splitting of the ring structure. The same reaction may also occur in the intact NAD molecule and will have an influence on the metabolic activity of coupled reactions. (auth)

22118 RADIOLYTIC TRANSFORMATION OF SULFIDES IN SULFATE BLACK LIQUORS. Chiu, S. T. Vancouver, B. C.; Univ. of British Columbia (1972). 314p.

Thesis.

The potentially volatile, malodorous sulfides (H_2S, CH_3SH, CH_3SCH_3 and CH_3SSCH_3) in sulfate black liquors were transformed to stable compounds by exposure to gamma photon radiolysis. The product complex following radiolysis of sulfides in aqueous solution is partly resolved as: polysulfide (from H_2S), sulfate (from H_2S, CH_3SH and CH_3SSCH_3), an intermediate, CH_3SSCH_3 (from CH_3SH), and a high molecular weight, amorphous substance (especially from CH_3SCH_3). (auth)

22119 RADIOLYSIS OF LIQUID NITROUS OXIDE. Sambrook, T. E. M. Edmonton, Alberta; Univ. of Alberta (1973). 223p.

Thesis.

The γ-radiolysis of liquid nitrous oxide has been investigated. The products formed are nitrogen, oxygen and nitrogen dioxide, yielding $G(N_2) = 13.1 \pm 0.2$, $G(O_2) = 2.6 \pm 0.1$ and $G(NO_2) = 5.6 \pm 0.2$ respectively. A mechanism is presented, which is consistent with the results obtained, and includes a novel combination of N_2O^+ and N_2O^- ions in the neutralization reaction. To support the mechanism, over thirty compounds were added to nitrous oxide solutions, and the changes in product yields measured. Generally the nitrogen yield decreased, whereas the yields of oxygen and nitrogen dioxide were eliminated as the additive concentration increased. Efficient electron scavengers, such as nitrogen dioxide and chloroform, have lower ionization potentials than nitrous oxide and when added to the nitrous oxide system, scavenged both electrons and positive ions. The results obtained complement the mechanism. With the addition of nitrous oxide to alkane solutions, nitrous oxide scavenged some of the electrons generated in the alkane, and thus inhibited hydrogen formation. Nitrous oxide was hence interfering with normal neutralization reactions of the alkanes, resulting in a decrease in the hydrogen yield and an increase in the nitrogen yield. A specific study was carried out to determine $G(H_2O)$ in the hydrocarbon/nitrous oxide system, and the results obtained accounted for the oxygen atoms released during radiolysis. (auth)

22120 RADIOLYSIS OF MONOIODOTYROSINE AND DIIODOTYROSINE LABELED WITH ^{125}I. Lambert, F.; Frapart, P.; Cohen, Y. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 24: No. 1, 115-124(1975). (In French).

Pulse radiolysis of MIT and DIT irradiated to doses from $2.8 \cdot 10^4$ to $85 \cdot 10^4$ rads was studied by ascending chromatography. The 3-iodo-4,5-dihydroxyphenylalanine (DOPA-I) and 3-iodo-4-hydroxyphenylalanine were identified as first stages of degradations of MIT and DIT, respectively. G values are 0.015 for MIT (10^{-5} M) and 0.004 for DIT ($0.5 \cdot 10^{-5}$ M). By self-decomposition MIT is degraded less rapidly than DIT and there is no formation of DOPA-I. (auth)

22121 INVESTIGATION OF THE PROCESS OF TRYPTOPHAN AQUEOUS SOLUTION HYDROLYSIS AND RADIOLYSIS. Petryaev, E. P.; Zhingunova, L. A.; Maksimuk, T. V.; Makarov, A. I. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki; Belorusskij Gosudarstvennyj Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 26-30(1973). (In Russian).

The radiation stability of tryptophan was investigated as a function of the type of radiation, the presence of CO_2 and pH. On the basis of the data obtained the protective action of CO_2 was established in the radiolysis of an aqueous tryptophan solution. The promoting effect of gamma-hydrolysis on the acidic and basic hydrolysis of tryptophan is shown. Observations were made of the effect of solution holding time on the degree of tryptophan destruction in the aqueous solution, and of the effect of type of radiation on the magnitude of the radiation decomposition of tryptophan. (tr-INIS)

22122 TECHNIQUE OF ELECTRON SPIN RESONANCE INVESTIGATIONS IN THE X-RAY FIELD. Lukiewicz, S.; Reszka, K. (Uniwersytet Jagiellonski, Krakow (Poland)). Folia Histochem. Cytochem. (Krakow); 11: 83-93(1973).

From 3rd meeting of the Polish Society of Radiation Research; Lodz, Poland (Apr 1973).

The technique of ESR measurements at X-band is described, which makes it possible to determine steady-state concentrations of free radicals in solids or liquids on simultaneous x-ray exposure at room temperature. Constant-flow sample holders are designed in such a way as to permit prolonged radiobiological experiments with living tissues kept in the x-ray field. The level of the absorbed dose of radiation can be read out of the ESR spectrum at any moment of exposure provided that suitable chemical dosimeters are used. (auth)

22123 STABILIZATSIYA RADIATSIONNO-MODIFITSIROVANNYKH POLIOLEFINOV. (Stabilization of Radiation-Induced Modified Polyolefins). Braginskij, R. P.; Finkel, E. E.; Leshchenko, S. S. Moscow; Khimiya (1973). 198p. (In Russian). 500 refs.

The aging and stabilization of irradiated polyolefines are considered. Data are presented about the effect of stabilizers on structure formation in polyolefines, the bond between the type of supermolecular structures and the thermostability of irradiated polyolefins, and methods of protecting irradiated materials from oxidation at elevated temperatures. (tr-INIS)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

22124 COMPUTER SIMULATION OF SOME REACTIONS OF ENERGETIC TRITIUM AND FLUORINE ATOMS. Malcolme-Lawes, D. J. (Kent Univ., Canterbury, Eng.). J. Chem. Soc., Faraday Trans., II; 70: No. 12, 1942-1952(1974).

A six body atom + tetrahedral molecule model of hot atom reactions is described and used to study the reactions of hot T and F atoms with CH_4 and CF_4. Excitation functions for all observed reactions are given for the energy range 0 to 30 eV. The functions are compared with the data available from recoil atom studies and found to be qualitatively consistent with the principal features of the experimental results. Of particular interest is the very high degree of internal excitation deposited in products following substitution reactions by hot F atoms with molecules containing at least two heavy atoms or groups. Using the F + CH_2F_2 system, it is shown that some substitution events occur in which more than 9.4 eV is deposited in the product molecule. (auth)

22125 CHEMICAL REACTIONS OF TRITIUM RECOIL ATOMS OF HIGH ENERGY WITH LIQUID HYDROCARBONS. P. 2. Some General Considerations to the Behaviour of the Tritium-Recoil Atoms. Jordan, P. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Radiochemie). Z. Phys. Chem. (Frankfurt); 86: No. 3-6, 209-219(Oct 1973). (In German).

Several general theoretical considerations are made concerning tritium recoil experiments in liquid phase. Models are considered, which are derived from existing models for recoil experiments in the gas phase and for Szilard-Chalmers experiments in liquid phase, and emphasize a collective interaction of recoil atoms and substrate. (auth)

Properties of Radioactive Materials

Refer also to abstracts 22048, 22623, 22978, 23043, 23141, 23144, and 25022.

22126 (EURFNR-1177) STUDIES ON THE REACTIVITY OF STEELS WITH SIMULATED FISSION PRODUCTS IN THE PRESENCE OF UO_2, $(U,Pu)O_2$ AND UC AND POSSIBLE WAYS OF IMPROVING THE COMPATIBILITY BEHAVIOR OF OXIDE FUEL PINS. Hofmann, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Mar 1974. Translation of KFK-1831. 275p. Dep. NTIS (US Sales Only) $16.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The reaction behavior of uranium oxide, uranium and plutonium mixed oxide, and uranium carbide with and without the addition of simulated fission products against austenitic stainless steels was investigated. First, an assessment of the compatibility conditions in the various cladding material-fuel-fission product systems was

made using the available thermodynamic data. Out-of-pile compatibility tests were performed with the thermodynamically unstable systems. The test temperatures varied between 200 and 1000°C, the annealing periods between 10 and 3000 h. The simulated burnup was 10 and 20 at. %. As cladding materials the austenitic steels 1.4401, 1.4541, 1.4970, 1.4981 and 1.4988 were tested. From ~30 fission product elements in the fuel during irradiation, only the elements Cs, Rb, I, Br, Te, and Se proved themselves reactive against the steels if an oxide fuel is used. The reaction behavior of a part of these fission products is strongly dependent on the oxygen potential in the system in addition to time and temperature. With increasing O/M-ratio of the fuel, the amount of reaction with the steels increases. With overstoichiometric oxide fuel cesium proved to be the most dangerous fission product, with substoichiometric fuel tellurium did so. First chemical interactions of the simulated burnup systems with the cladding materials take place at 400°C. The kinetic evaluation of the fission product reactions with steels resulted in a parabolic time law for the cladding attack at temperatures up to 700°C (n = 0.5). Above 700°C a decrease of the exponent n of the time law from 0.5 to 0.2 and 0.3 can be found. With O/M-ratios of the fuel below 2.00 only weak interaction of the fission products with the steels can be observed even at 800°C. With the use of suitable oxygen getters in the fuel pin it is therefore possible to keep the oxygen potential in the fuel low enough that the dangerous Cs-reactions with the cladding do not take place. Two methods of inserting getters into the fuel pin were investigated: local getters (Ti,Zr) and inner coating of the tube (Nb). With the carbide fuel the fission products do not determine the compatibility behavior with the steels but the carbon potential of the fuel. Only a carburization of the cladding takes place, which is not influenced by the fission products. In the carbide fuel the fission products react only with themselves or with the UC or (U,Pu)C. The use of carbide fuel in fast breeder reactors therefore has an advantage against the oxide fuel in respect to the compatibility behavior especially at high temperatures and burnup. (auth)

22127 MOESSBAUER EFFECT OF ^{127}I IN THYROID COMPOUNDS. Oberley, L. W.; Hershkowitz, N.; Ehrhardt, J. C. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Phys. Lett., A; 50: No. 2, 77-78(18 Nov 1974).

Four compounds present in the thyroid were studied via the Moessbauer effect of naturally occurring ^{127}I. DIT and T_4 had similar spectra. The spectra from MIT could be distinguished from that of DIT and T_4. (auth)

22128 THE NEUTRON SPECTRUM OF PLUTONIUM FLUORIDE. Massand, O. P.; Venkataraman, G. (Bhabha Atomic Research Centre, Bombay (India)). Nucl. Instrum. Methods; 121: No. 2, 405-406(15 Oct 1974).

The neutron spectrum of PuF_4 was theoretically calculated using the measured total $^{19}F(\alpha,n)^{22}Na$ cross sections, and compared with available experimental data. There is good agreement with regard to the main peak as well as the maximum energy of the spectrum. The calculated spectrum explains all the features of the observed spectrum. (auth)

22129 M-IODOHIPPURIC ACID LABELLED WITH RADIOACTIVE IODINE AND PROCESS FOR ITS PREPARATION. Elias, H. H. US Patent 3,859,429. 7 Jan 1975. Filed date 7 Jul 1972. 4p.

Novel m-iodohippuric acid labelled with radioactive iodine and the salts thereof with physiologically compatible bases are described as well as their use in kidney function studies and for kidney scanning. (Official Gazette)

22130 TECHNETIUM-99m ALBUMIN AGGREGATES. Bruno, G. A.; Haney, T. A.; Rajamani, P. N. (to E. R. Squibb and Sons, Inc.). US Patent 3,862,299. 21 Jan 1975. Filed date 26 Jun 1973. 6p.

Disclosed herein is an aggregate comprising coprecipitated ^{99m}Tc sulfur colloid and denatured albumin colloid. These aggregates can be utilized in scanning lungs to determine the health of the pulmonary circulation. (Official Gazette)

22131 NEW TYPE OF BLUE TERNARY COMPLEX OF ARSENAZO I WITH PLUTONIUM(IV) IN THE PRESENCE OF HYDROGEN PEROXIDE. Preliminary Investigation. Perez-Bustamante, J. A. (Junta de Energia Nuclear, Madrid). Talanta; 21: No. 12, 1291-1295(Dec 1974).

The preparation and spectrophotometric properties of a new type of complex compound of arsenazo I with Pu(IV) in the presence of H_2O_2 are described. The new compound has a blue color, derived from a wide absorption band with a maximum at 610 nm, and a corresponding molar absorptivity of 4×10^4 l. mole^{-1} cm^{-1}. From 2 hr after its preparation this curious new compound undergoes for several days a steady decomposition accompanied by decolorization. The formation of similar peroxy Pu(IV) complexes has not so far been shown to take place with arsenazo III or with any other "arsenazo-type" reagent. (auth)

22132 PREPARATION AND APPLICATION OF RADIOPHARMACEUTICALS. I. Introduction. Komarek, P.; Chalabala, M. (Inst. for Postgraduate Medical and Pharmaceutical Studies, Prague). Farm. Obz.; 42: No. 11, 499-504(1973). (In Czech).

The fundamental notions in the sphere of radiopharmaceuticals are listed, their classification according to physical properties and diagnostical application is given, and their preparation is briefly described. The quality evaluation of radiopharmaceuticals is discussed, and the necessity is stressed of proper designation of preparations and of documentation on radioactive substances. (Nucl. Sci. Abstr. Czech.)

22133 PREPARATION OF IODINE-123 LABELLED CONTRAST AGENTS. Thakur, M. L. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 576-578 (Dec 1974).

An efficient method of labelling Conray (3-acetamido-5-methylcarbamyl-2,4,6-tri-iodobenzoic acid) and Hypaque (3,5-Diacetamido-2,4,6-tri-iodobenzoic acid) with ^{123}I by isotopic exchange in aqueous solution, is described. These benzoic acid derivatives containing three iodine atoms can be used in urography as contrast media. The media prepared in the described manner have a specific activity of 0.1 mCi/mg, can be autoclaved for sterilization and are stable chemically and radiochemically until the ^{123}I activity is decayed. (UK)

22134 PRODUCTION OF ^{99m}Tc LABELLED ALBUMIN MICROSPHERES FOR LUNG CLEARANCE STUDIES AND INHALATION SCANNING. Yeates, D. B.; Warbick, A.; Aspin, N. (Univ. of Toronto). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 578-580(Dec 1974).

The preparation of microspheres of human serum albumin, which meet the requirements necessary for lung clearance studies and inhalation scans (viz., they should be particulate, easily aerosolized, unlikely to affect mucociliary transport, biodegradable, sterile, have a long shelf life, and be readily and firmly tagged with a radioisotope label) is described. The labelling radioisotope used was ^{99}Tc obtained from a column generator. The microspheres have a count median diameter of 0.5 μm, a mass median diameter of 1.1 μm and a geometric standard deviation of 1.8. A suspension of 1 mg/ml of the microspheres was calculated to contain about 2×10^9 particles/ml. The microspheres have been used following storage for over 6 months. The labelling procedure is rapid, gives a high yield and a relatively stable product, properties which make the method very attractive for routine use. (UK)

22135 TRANSITION ELEMENTS. Prescott, A.; Sharp, D. W. A. (Univ. of Glasgow). Annu. Rep. Progr. Chem., Sect. A; 70: 367-417(1973).

The report includes sections on the following transition elements of importance in nuclear technology: scandium, yttrium and lanthanides, the actinides, zirconium and hafnium, vanadium, niobium and tantalum, tungsten and molybdenum, technetium and rhenium, ruthenium. It is stated that general topics that have been considered or reviewed this year include the MO theory of transition-metal complexes and valency in transition-metal compounds; the radii and the relation between the radii and electronic configurations of the 5f-6d metals; the trans effect; synthesis involving atomic species in matrices; the geometry and molecular and ligand rearrangements of five-, six-, and eight- coordinate complexes; metal hydrides; isocyanide complexes; polynuclear metal cyanides; compounds containing M-Si σ-bonds; nitrido and coordinated azide derivatives; thio- and seleno-compounds of d^0 species; fluorides; halides and oxyhalides of the early transition elements. (UK)

22136 INFLUENCE OF ZIRCONIUM ON THE LABELLING OF ALBUMIN MACROAGGREGATES WITH ^{113m}In. Caro, R. A.; Ciscato, V. A.; Ihlo, J. E.; Nicolini, J. O.; Palcos, M. C.; Radicella, R. (Buenos Aires Univ. Nacional). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 501-507(Dec 1974).

Physicochemical and biological investigations are described, by which it was demonstrated that the incorporation of 20 μg of Zr(IV) and 4 mg of Na_2HPO_4 per milliliter of suspension are necessary to fix ^{113m}In to the albumin macroaggregates (MAA). In this way the separation of the label in vivo, due to the presence of plasma transferrin can be prevented. The preparation of ^{113m}In-labelled MAA was standardized for its utilization as a reproducible tracer for lung scintiscanning. (auth)

22137 QUANTITATIVE STUDY OF THE NpO_2^{++}–NpO_2^+ SYSTEM IN FUSED LiCl–CsCl (55-45 mol. %). Lysy, R.; Duyckaerts,

G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 11: No. 2, 79-88 (Feb 1975). (In French).

The following reactions: $NpO_2^{++} + Cl^- \rightleftharpoons NpO_2^+ + \frac{1}{2}Cl_2$ and $NpO_2^{++} + 4HCl \rightleftharpoons Np^{4+} + 2H_2O + Cl_2 + 2Cl^-$ have been examined from a quantitative point of view in LiCl-CsCl (55 to 45 mol %) in the temperature range 400 to 550°C by sparging definite composition gas mixtures (N_2, Cl_2) in the melt, the concentrations being evaluated by visible and near infrared absorption spectrophotometry. The values of the equilibrium constants are at 450°C: $K_1 = (1.60 \pm 0.09)$ atm$^{\frac{1}{2}}$, $K_2 = (3.2 \pm 0.3)\ 10^{-4}$ atm$^{(-1)}$. The standard potential referred to the chlorine normal potential has also been evaluated. $[E^0 NpO_2(VI)/NpO_2(V)]400°C = 0.0055$ V. (auth)

22138 $CaU_2O_6F_2$, A FLUOROURANATE ISOTYPIC WITH U_3O_8. Fonteneau, G.; L'Helgoualch, H.; Lucas, J. (Univ., Rennes, France). Inorg. Nucl. Chem. Lett.; 11: No. 3, 207-212(Mar 1975). (In French).

An account is given of the preparation of calcium fluorouranate $CaU_2O_6F_2$ according to the scheme $CaUO_4 + UO_2F_2 \rightarrow CaU_2O_6F_2$. The crystal structure is derived from x-ray diffraction results. Molecular structure is discussed in relation to the infrared spectra. (UK)

22139 QUANTITATIVE STUDY OF THE NpO_2^+-Np^{4+} SYSTEM IN FUSED LiCl-CsCl (55-45 mol. %). Lysy, R.; Duyckaerts, G.. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 11: No. 2, 89-99(Feb 1975). (In French).

The following reaction: $NpO_2^+ + 4HCl \rightleftharpoons Np^{4+} + 2H_2O + \frac{1}{2}Cl_2 + 3Cl^-$ has been studied quantitatively at different temperatures in a LiCl-CsCl melt (55 to 45 mol %), by sparging gas mixtures (H_2O, HCl and Cl_2) of definite composition in the melt, the evolution of the reaction being followed spectrophotometrically. The value of the equilibrium constant is, at 450°C $K = (2.0 \pm 0.1)10^{-4}$ atm$^{-\frac{1}{2}}$. The mean values of ΔH and ΔS in the temperature range 450 to 600°C are: $\Delta H = (-51 \pm 7)$kJ mol^{-1}, $\Delta S = (-141 \pm 5)$J mol^{-1} K^{-1}. (auth)

22140 PREPARATION AND PROPERTIES OF TRICHLOROBIS(PENTANE-2,4-DIONATO) PROTACTINIUM(V), TETRAKIS (1,3-DIPHENYLPROPANE-1,3-DIONATO(PROTACTINIUM(IV), AND TETRAKIS(PENTANE-2,4-DIONATO)ACTINOID(IV) COMPLEXES. Brown, D.; Whittaker, B.; Tacon, J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Chem. Soc., Dalton Trans.; No. 1, 34-39(1975).

Trichlorobis(pentane-2,4-dionato)protactinium(V), $[PaCl_3(pd)_2]$, has been obtained from the reaction between protactinium pentachloride and pentane-2,4-dione (Hpd) in methylene dichloride, and $[Pa(dppd)_4]$ and $[Pa(dp)_4]$ (dppd = 1,3-diphenylpropane-1,3-dionato) from reactions involving the thallium salt of the appropriate chelate and $[Et_4N]_2[PaCl_6]$ and $PaCl_4$, respectively, in oxygen-free non-aqueous solvents. Oxidation of $[Pu(pd)_3]$ in solvents such as benzene and ethanol in the presence of Hpd yields $[Pu(pd)_4]$. Attempts to prepare $[Am(pd)_4]$ and complexes of the type $M[Th(pd)_5]$ (M = univalent cation) have been unsuccessful. X-ray diffraction results are reported for the above complexes, together with details of conditions necessary for formation of the α and β phases of the tetrakis(pentane-2,4-dionato) actinoid (IV) complexes. Solid-state spectral results (0.5 to 2.2 μm) are provided for β-$[Pa(pd)_4]$, β-$[U(pd)_4]$, β-$[Pu(pd)_4]$, and $[Pu(pd)3]$ together with IR results for these complexes, those of the type $[M(pd)_4]$ (M = Zr, Hf, Ce and Th), and $[PaCl_3(pd)_2]$. (auth)

22141 BINARY MOLYBDATES OF THORIUM WITH POTASSIUM, RUBIDIUM, AND CESIUM. Bushuev, N. N.; Trunov, V. K. (Moscow State Univ.). Dokl. Chem. (Engl. Transl.); 217: No. 4-6, 533-535(Aug 1974).

Translated from Dokl. Akad. Nauk SSSR; 217: No. 4, 827-829 (Aug 1974).

Me_2MoO_4-$ThMo_2O_8$ systems were studied including determination of the structural relationships of the compounds formed in the systems (Me = K, Rb, Cs). The investigation was carried out by x-ray phase analysis. Stoichiometric mixtures of the Me_2MoO_4 and thorium molybdate were annealed at 500-650°C for times of the order of 200 hr. (LK)

22142 PROCESS FOR PREPARING DRUGS OF POLYVINYLPYRROLIDONE IODINE, LABELLED WITH RADIOACTIVE IODINE. Stanko, V. I.; Brattsev, V. A.; Vostrikova, T. N. pp 203-207 of Proiz-vo Isotopov. Moscow; Atomizdat (1973). (In Russian).

During the formulation of stable, radioactive diagnostic preparations of polyvinylpyrrolidone, a study was made of the possibility of preparing different copolymers of n-vinylpyrrolidone with p-vinylphenol. Copolymers were prepared having a weight ratio of the initial monomers of from 50 : 1 to 200 : 1. The iodination reaction using chloroiodine labelled with ^{131}I was carried out with a 200 : 1 polymer. The obtained preparation of polyvinylpyrolidone(I) labelled with the radioactive iodine was purified by passing it through a column containing an ion-exchange resin. After purification (I) was stabilized during storage in an aqueous solution and sterilized by heating to 120°. (I) was stable towards the action of enzymes of the alimentary and intestinal tract such that radioactive label is very stable. During the storage of (I) for one year, the formation of inorganic ^{131}I was not observed. (Referativnyi Zh.)

22143 TRIBOLUMINESCENCE OF URANYL NITRATE. Zink, J. I. (Univ. of California, Los Angeles). Inorg. Chem.; 14: No. 3, 555-558(Mar 1975).

The triboluminescence (TL) of uranyl nitrate hexahydrate is a phosphorescence centered on the uranyl ion. The vibronic structure in both the TL and the photoluminescence spectra have the same relative intensities and energy spacings as is expected when the lifetime of the TL is long compared to mechanical relaxation processes in the crystal. The title compound is the first nonaromatic molecule whose TL originates from a molecular excited state and not from a gas discharge. The physical origins of the TL within a crystal and the implausibility of an intramolecular TL excitation mechanism are discussed. (auth)

22144 MIXED LIGAND DERIVATIVES OF Th(IV)-CDTA CHELATE WITH SOME HYDROXY ACIDS. Pachauri, O. P.; Tandon, J. P. (Univ. of Rajasthan, Jaipur, India). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 11, 981-986(Dec 1974).

Studies of mixed ligand derivatives of 1:1, Th(IV)-CDTA diaquo chelate with some monohydroxy-monocarboxylic acids, viz. lactic, mandelic and O-hydroxy naphthoic acids were carried out potentiometrically at 30 ± 1°C. The formation of the mixed ligand chelates was indicated at pH > 6. Equilibrium constants of the resulting 1:1:1 complexes were calculated. (auth)

22145 ANALYTICAL CONTROL OF A RADIOPHARMACEUTICAL USING A CATHODE RAY POLAROGRAPH. Thakur, M. L. (Hammersmith Hospital, London). J. Radioanal. Chem.; 24: No. 1, 89-97(1975).

A method was developed for chemical control of a short-lived radiopharmaceutical, ^{52}Fe. The optimum conditions were investigated for the simultaneous determination of microgram amounts of nickel, iron and chromium in an admixture. The method developed is applicable for the determination of 0.01 to 20 $\mu g \cdot ml^{-1}$ of nickel, 0.01 to 50 $\mu g \cdot ml^{-1}$ of iron and 0.05 to 50 $\mu g \cdot ml^{-1}$ of chromium. A study was made of the mutual interference of these elements at different concentrations, and also of the interference by various other cations and anions. A list was given of the other elements that can be analysed using the supporting electrolyte. A method of routine analysis is described. (auth)

22146 RELATION BETWEEN ACTIVITY AND DIFFUSION COEFFICIENTS OF THORIUM(IV) IN MOLTEN ALKALI-METAL CHLORIDES. Smirnov, M. V.; Komarov, V. E.; Kudyakov, V. Ya.; Borodina, N. P.; Posokhin, Yu. V. (Inst. of Electrochemistry, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 48: No. 6, 930-931(Jun 1974).

Translated from Zh. Fiz. Khim.; 48: No. 6, 1578-1579(Jun 1974).

The dependence on temperature and on the cationic radius of the salt medium was determined for the activity and diffusion coefficients of quadrivalent thorium. The relation found between them enables diffusion coefficients to be calculated for quadrivalent thorium, over wide ranges of concentration in various mixtures with alkali-metal chlorides, from known values of its activity coefficients. The coefficient of self-diffusion of quadrivalent thorium has been estimated as 8.8×10^{-5} at 1100°K. (auth)

22147 PLUTONIUM VALENCE STATE DISTRIBUTIONS. Silver, G. L. (Monsanto Research Corp., Miamisburg, OH). J. Radioanal. Chem.; 23: No. 1-2, 195-197(1974).

A method for ascertaining equilibrium valence state distributions of plutonium in acid solutions as a function of the plutonium oxidation number and the solution acidity is illustrated with an example. The method may be more practical for manual use than methods based upon polynomial equations. (auth)

22148 ASSAYS OF RAT HEMOGLOBIN FRACTIONS BY LABELLING WITH ^{131}I. Szyszko, A. (Wojskowy Instytut Higieny i Epidemiologii, Warsaw (Poland)). Acta Pol. Pharm.; 30: 539-544(1973). (In Polish).

For English translation see the journal Pol. Pharm. Trans.

A method of labelling with ^{131}I for the determination of particular fractions of hemoglobin, separated by thin-layer electrophoresis on starch gel, is described. (auth)

22149 RADIOCHEMICAL PURITY DETERMINATION OF ^{18}F PREPARATIONS. Noto, M. G.; Nicolini, J. O. (National Atomic Energy Commission, Buenos Aires). J. Radioanal. Chem.; 24: No. 1, 85-87(1975).

A simple and fast chromatographic method for determining the chemical form of ^{18}F is given. (auth)

22150 INVESTIGATION OF HEXAVALENT URANIUM HYDROLYTICAL PROPERTIES. Davydov, Yu. P.; Efremenkov, V. M. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 21-25 (1973). (In Russian).

The hydrolysis of hexavalent uranium with the formation of mononuclear hydrolysis products was investigated. The study was carried out at a uranium concentration of 10^{-5} to 10^{-6} mols at pH values of 1.0 to 5.0. It was established that under these conditions the results of the studies are not distorted by the absorption of uranium on glass and collodial solution impurities, and also the formation of polynuclear hydrolysis products is not observed. The methods of ion-exchange and spectrophotometry in combination with the organic reagents Arsenazo-I and Arsenazo-III are used in the study. The value of the first hydrolysis constant of the uranyl ion was calculated to be $K_1 = (3.7 \pm 1.5)\ 10^{-4}$. (tr-INIS)

Radioactive Waste Treatment

Refer also to abstracts 22053, 22863, and 23436.

22151 (COO-3049-5, pp 67-90) PRESSURE-SWING SORPTION CONCENTRATION OF KRYPTON-85 FOR PERMANENT STORAGE. Ayers, J. W.; Goldin, A. S.; Underhill, D. W. Dec 1974.

In semiannual progress report, March 1, 1974–August 31, 1974.

The concentration of krypton-85 from the off-gas of a nuclear fuel reprocessing plant by pressure-swing adsorption-desorption is under investigation at the Harvard School of Public Health. System specifications include a decontamination factor of 10^4 for discharged gas and a concentration factor of 10^3 for the stored gas. The basic system element is a bed moving countercurrent to the gas flow. In the high pressure leg, krypton is adsorbed by the activated carbon, providing a cleaned gas output. The carbon then passes through a depressurization zone into the low-pressure leg, purged of remaining krypton by a countercurrent flow of clean gas, and then repressurized and reintroduced into the high pressure leg. The depressurization and purge streams constitute the krypton concentrate. The output of the high pressure leg, minus the purge and repressurization gas, represents the clean gas throughput. Overall concentration requirements are met by reflux and/or cascade of these elements. Calculations of the quantity of charcoal and power required are presented for three different adsorbent flow rates, with given plant performance specifications. These calculations illustrate the effect of flow rate on the trade-off of size vs. power. (auth)

22152 WASTE SOLIDIFICATION: CEMENT OR UREA FORMALDEHYDE. Heacock, H. W.; Riches, J. W. Paper No. 74-WA/NE-9. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A number of different processes have been proposed and are utilized for the solidification of radioactive wastes from nuclear power plants. In the last several years, two different types of solidification systems have been most commonly utilized for this purpose. These systems utilize Portland cement or an organic polymer, urea formaldehyde, as the solidifying agent. The properties and characteristics of Portland cement and urea formaldehyde in the solidification of various types of nuclear plant wastes are reviewed. Due to the substantial effect of raw material, packaging, shipping, and disposal costs on total system operational cost, the most economical type of solidification system may not be the same in all instances. The purpose of this paper is to present comparative data regarding the various parameters affecting radwaste solidification system operation as a guide for plant designers and operators in the selection of a system for a particular application. (auth)

22153 FINAL DISPOSAL OF SOLID RADIOACTIVE WASTES: TECHNIQUE FORESEEN IN ITALY. Branca, G. (CNEN, Rome). Ing. Ambientale; 2: No. 3, 287-293(1973).

Current practices of radioactive solid wastes disposal in Italy are described. The future production of wastes from the nuclear power industry and nuclear research centers is estimated. Two categories of waste disposal are considered: short-term containment of up to a few centuries for wastes without large quantities of long-lived α emitters and long-term containment of several hundreds of thousands of years for wastes containing long-lived α emitters (substantially ^{239}Pu) in concentrations higher than given threshold values. The management scheme for wastes requiring short-term containment comprises possible conditioning (inclusion in concrete) and forecasts shallow burial or introduction to deep geological formations, e.g., abandoned mines. Sea dumping is also considered as a possible final disposal method. Present Italian philosophy on the disposal of radioactive wastes requiring long-term containment favors solidification of liquids and, after temporary storage, introduction to adequate deep geological formations, e.g., bedded salt or suitable clay formations. Investigations carried out on plioquaternary clay formations in southern Italy gave encouraging results for possible application. (Pollut. Abstr.)

22154 LEACHABILITY EVALUATION OF RADWASTE SOLIDIFIED WITH VARIOUS AGENTS. Leonard, J. H.; Gablin, K. A. Paper No. 74-WA/NE-8. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A simple readily reproducible test of leachability has been applied to radioactive liquids solidified respectively with cement, urea-formaldehyde (UF) resin, and an augmented UF-base agent know as Tiger Lock. Dilute aqueous solutions of $^{22}Na^+$, $^{57}Co^{2+}$, $^{60}Co^{2+}$, $^{85}Sr^{2+}$, $^{109}Cd^{2+}$, and $^{137}Cs^+$ as soluble ions were prepared and mixed with each solidificant agent in proportions spanning the range of nuclear power plant practices. After curving and counting initial gamma activity of each nuclide, the small samples were immersed continuously in gently flowing tap water. Samples were temporarily retrieved weekly for counting of activity remaining. Results expressed as initial activity fraction retained with increasing leach time thus far indicate that leach rates are substantially different for individual radionuclides and are strongly affected by liquid proportion for all solidification agents tested, by composition and source of urea-formaldehyde resin, and by addition of boric acid for cement and sodium sulfate for the resins. Leach resistance appears not necessarily associated with physical strength of solidified product. Tiger Lock brand of solidification agent containing additives has exhibited significantly better leach resistance than resin alone. Additional tests have been undertaken to evaluate other characteristics pertinent to transportation and burial of solidified wastes. (auth)

22155 CONVERSION PROCESS FOR WASTE NITROGEN-CONTAINING COMPOUNDS. Dotson, J. M.; Peters, T. E. (to General Electric Co.). US Patent 3,862,296. 21 Jan 1975. Filed Date 9 Feb 1972. 12p.

A process is presented for converting nitrogen-containing compounds in which at least a portion of the nitrogen has a positive valence to molecular nitrogen by calcining the nitrogen-containing compounds in a fluidized bed in the presence of a reducing agent selected from the group consisting of ammonia, ammonium compounds and mixtures thereof. The process may be used in processing wastes from spent fuel reprocessing. (Official Gazette)

22156 USE AND ECONOMIC ADVANTAGES OF FLUID BED CALCINERS FOR VOLUME REDUCTION OF LIQUID RADWASTE. White, L. E.; Garcia, R. Paper No. 74-WA/NE-5. New York; American Society of Mechanical Engineers (1974). 13p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Disposal of radioactive wastes via the unique Aerojet VR-20 Radioactive Waste Management System offers the utility potential annual cost savings of several hundred thousand dollars over the conventional processes utilizing cement, cement/vermiculite or urea-formaldehyde solidification. Other benefits which accrue to the user include less waste storage space requirements, fewer packages of radioactive material to be handled, lower integrated dose to workers, and less likelihood of transportation accidents. In addition, application of this system to the Nuclear Power Plant Industry will result in an increased longevity of commercial burial sites and an overall reduction in the number of burial sites required to support the industry. (auth)

22157 HETEROGENEOUS EXCHANGE REACTIONS OF UNSTABLE SIMPLE SYSTEMS. Azzam, A. M.; El-Atrash, A. M.; Ghattas, N. K. (Ain Shams Univ., Cairo). J. Radioanal. Chem.; 23: No. 1-2, 63-71(1974).

Carrier-free strontium and cesium isotopes were used to study the heterogeneous exchange of the systems strontium/strontium carbonate and cesium/cesium tetraphenylborate. The elements under consideration are among the long-lived isotopes most desired to be removed from waste solutions and consequently the use of heterogeneous exchange as an applied phenomenon for selective fixation is possible. The results obtained show that the above two systems are unstable ones (i. e. undergoing either formation or dissolution of the precipitated solid phase). New modified equations were proposed for quantitative calculation of the fraction of exchange, using

only radiometric data and avoiding the use of microanalytical data. The equations are useful for all unstable systems, especially if no precise microquantitative method of analysis is known for the element under consideration. Recrystallization and self-diffusion were proposed to explain the two parts characterizing the exchange curves. (auth)

22158 CONCENTRATION OF RADIOACTIVE FERRIC HYDROXIDE SLUDGE AND RECYCLE SOLUTIONS BY COMBINED EVAPORATION. Trofimov, D. I.; Barabanov, A. I. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 833(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 193(Sep 1973). This is a summary of paper No. 689/7245 with full copy held at TIC.

On the basis of results of investigations of combined evaporation of ferric hydroxide sludge and recycle solutions and the work done in adapting this arrangement to production, it was shown that the separate concentration of hydroxide sludge and recycle slurry makes it possible to reduce waste bulk by only 250 times, whereas combined evaporation brings the concentration ratio up to 500. This results in a significant reduction in the costs of reprocessing radioactive waste slurries. (LK)

Radioisotope Production

Refer also to abstracts 22051, 23046, and 25051.

22159 PRODUCTION OF ^{123}I VIA THE ^{127}I(d,6n)^{123}Xe(β^+,EC)^{123}I PROCESS. Weinreich, R.; Schult, O.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 535-543(Dec 1974).

The bombardment of iodine with ≃ 70-MeV deuterons can be conveniently used for routine production of ^{123}I (T = 13.3 hr) for nuclear medical applications. Excitation functions of the relevant ^{127}I(d, xn) and ^{127}I(d, pxn) reactions have been determined by means of the stack-foil technique within the energy range of 10 to 90 MeV. The cross section of the ^{127}I(d, 6n)^{123}Xe process has a flat maximum with σ = 300 mb at a deuteron energy of 69 MeV. A thick NaI-gas flow target has been developed which allows a continuous removal of the ^{123}Xe parent with an efficiency of about 80%, allowing the production of ^{123}I with a thick target yield of 8 mCi/μAh at an ^{125}I impurity level of ≤0.2%. (auth)

22160 ^{113}Sn^{113m}In RADIOISOTOPE GENERATOR SYSTEMS. Arino, H.; Kramer, H. H. (Union Carbide Corp., Tuxedo, NY). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 493-496(Dec 1974).

New ^{113}Sn/^{113m}In generator systems were developed to produce high-purity ^{113m}In with high efficiency when using dilute hydrochloric acid as the eluant. These new systems are based on the chemical adsorption of ^{113}Sn on hydrous zirconium oxide (HZO) or on silica gel by heating ^{113}Sn(IV) in the presence of bromine water and 0.4M HCl. The adsorption capacity for HZO and silica gel was 12 mg Sn/g HZO and 6 mg Sn/g silica gel, respectively. In both cases, >99% of the ^{113}Sn was adsorbed and the separation factor for Sn/In was >10^4 when the pH of the eluting solution was greater than 1.2. In general, the silica gel system had superior operating characteristics when compared to the HZO system: higher recovery of ^{113m}In over a greater pH range was observed. In addition, the silica gel system could tolerate autoclaving much better than the HZO system. (auth)

22161 MINIGENERATOR FOR THE PRODUCTION OF KRYPTON-81m AND ITS APPLICATIONS. Mayron, L. W.; Kaplan, E.; Colombetti, L. G.; Friedman, A. M.; Gindler, J. E. (Veterans Administration Hospital, Hines, IL). Int. J. Nucl. Med. Biol.; 2: No. 1, 40-42(Jan 1975).

Alpha irradiation of bromine (cuprous bromide) in a cyclotron gave ^{81}Rb, the parent of ^{81m}Kr. A convenient minigenerator and delivery system have been developed to produce either gaseous or isotonic dextrose-in-water solutions of ^{81m}Kr, (without ^{81}Rb), as and when required, for scintigraphic use in clinical studies. The clinical performance of the samples of ^{81m}Kr obtained has been tested with ventilation and perfusion scintigrams of the lungs, selective arterial angiography and studies of the mechanics and kinetics of deglutition. The short half-life (13 sec) of the ^{81m}Kr resulted in minimal radiation exposure to the patient, despite the high gamma photonflux, and very little environmental radiation contamination. (UK)

22162 SEPARATION OF CARRIER-FREE ^{85}Sr FROM A CYCLOTRON TARGET. Kopecky, P.; Mudrova, B. (Ustav Jaderneho Vyzkumu, Rez, Czech.). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 469-470(Oct 1974).

Experimental data are presented concerning the chemical separation of carrier-free ^{85}Sr from rubidium chloride solution. The solution was obtained from dissolving a cyclotron target, consisting of a RbCl layer on a supporting silver disk, in warm water. The adsorption of strontium and rubidium was investigated on Al_2O_3 (Merck) using ^{85}Sr and ^{86}Rb as tracers. Results show that the pH range 7.5 to 9 is most suitable for the separation of carrier-free ^{85}Sr from macro-amounts of rubidium. Following dynamic experiments using 12-mm-dia columns loaded with Al_2O_3 (Merck), experimental data on the effect of HCl concentration on the yield and on the shape of the elution curve are presented. The recommended procedure for the separation is given from which a yield of the order of 90 to 95% is obtained, the time required for chemical processing being about 2 hr. (UK)

22163 IMPROVED GENERATOR OF ^{131m}Xe. McFarland, R. C. (Georgia Inst. of Tech., Atlanta). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 567-568(Dec 1974).

A ^{131m}Xe generator is described which uses a commercially available syringe and syringe filter with the ^{131}I, from which the ^{131m}Xe is produced by decay, held as PdI_2 on a glass fiber filter. Ten millicuries ^{131}I was precipitated as PdI_2, placed in the generator, and allowed to decay for 10 days. The syringe filter was uncapped and 5 ml of air was drawn into the syringe through the 2 ml syringe filter sweeping out the ^{131m}Xe. The syringe was disconnected, capped, and counted on a Ge(Li) detector for both ^{131m}Xe and ^{131}I. The yield of ^{131m}Xe was consistently greater than 90% of the calculated amount. No ^{131}I was detected in the product giving a ratio of (^{131m}Xe : ^{131}I) greater than 200:1. The ease of construction and operation, together with the high degree of product radiochemical purity, makes this a practical generator design when small amounts of a gaseous tracer are required. (UK)

22164 PHOTONUCLEAR PRODUCTION OF POTASSIUM-38. Cole, C.M.; Gray, F.C.; Meaburn, G.M.; Stevenson, J.S. (Armed Forces Radiobiology Research Institute, Bethesda, Maryland 20014). Med. Phys. 1: No. 6, 326-327 (Nov 1974).

Radioactive potassium-38 has been produced by the photonuclear reactions ^{39}K(γ,n)^{38}K and ^{40}Ca(γ,np)^{38}K, using the bremsstrahlung field developed by an electron linear accelerator. Non-carrier-free ^{38}K was produced by irradiating potassium hydroxide pellets for 30 min using 10 kW of 40 MeV electrons passing through a thick tantalum converter. Yields of 25-35 mCi ^{38}K per gram irradiated KOH were obtained. Carrier-free ^{38}K was produced by similarly irradiating shredded calcium metal, obtaining 2-6 mCi per gram of calcium. In both cases, the target material was dissolved in HCl, neutralized, and prepared as sterile solutions of KCl for injection. (auth)

22165 STUDY OF ^{113m}In GENERATOR. Oniciu, L.; Veglia, A. (IAEA, Seibersdorf, Austria). J. Radioanal. Chem.; 24: No. 1, 99-114(1975).

Methods are proposed for the determination of ^{113}Sn in the eluate of an ^{113m}In generator as well as for the analysis of its chemical and radionuclidic purity. Two generators of different origin have been studied. The radioisotopes ^{113}Sn, ^{125}Sb, ^{125m}Te and the elements Zr, Si and Fe were found in the eluate. Recommendations are given for the use of such generators. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 22616.

22166 (ANL-Trans-968) APPLICATION OF A LASER BEAM TO FUEL ELEMENT DECLADDING. Martin, J.; Bernard, J. Jan 1975. Translation of Paper No. 18, Session 7. (CONF-721062-5). 15p. Dep. NTIS $4.00.

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

A process for fuel element decladding by laser beam was tested. After determining the main parameters involved, numerous tests allowed a determination of their influence and the possible performance. The advantages of this method compared to the more conventional ones are numerous in terms of equipment design, operating flexibility, reliability as well as reduction of contamination risks. A design study of a hot-cell installation is suggested. (auth)

22167 (ICP-1060) IDAHO CHEMICAL PROCESSING PLANT PILOT PLANT COMPUTER SYSTEM. Groth, F. M. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). Jan 1975. Contract AT(10-1)-1375. 172p. Dep. NTIS $7.60.

A minicomputer-based data acquisition and display system has been installed in the industrial pilot plant at the Idaho Chemical Processing Plant. The system includes disk mass storage, process signal interfaces, a display terminal and two minicomputers operating in a master-slave mode. The signals, sample rates and environment of this pilot plant are typical of many industrial

applications. Problems encountered in the project and goals established for the system are discussed. Hardware and software for the system are analyzed in light of these problems and goals. Particular emphasis is placed on software which accomplishes high speed intercomputer communication via standard asynchronous serial interfaces. The completed system is evaluated in terms of system expandibility, data reliability, and data rates. (auth)

22168 (REG/G-3.26(2-75)) STANDARD FORMAT AND CONTENT OF SAFETY ANALYSIS REPORTS FOR FUEL REPROCESSING PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Feb 1975. 105p. NRC.

This standard format and content report identifies the type of information needed, emphasizes in various areas the depth of detail required in the two reports (PSAR, FSAR), and indicates the desired format to facilitate an orderly review. (LK)

CONTROLLED THERMONUCLEAR RESEARCH

Plasma Confinement and Heating

Refer also to abstracts 22225, 22242, 22254, 22344, and 22479.

22169 (CEA-CONF-2729) Rf-HEATING OF FUSION REACTORS. Canobbio, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1974. 11p. (CONF-740642-3). Dep. NTIS (US Sales Only) $4.00.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

The main aspects of the rf-heating approach to the ignition problem in low-beta toroidal devices are discussed. The processes analyzed in some detail are: ion and electron TTMP, ICRH including heating at multiples of the ion gyrofrequency, and heating at the lower hybrid resonance. Emphasis is put on the basic physical scaling laws relevant to ignition, on the essential questions which remain to be settled, and on the main technical constraints upon the application of the various rf-schemes in reactor oriented devices. (auth)

22170 (CEA-CONF-2730) LHR HEATING SLOW WAVE LAUNCHING STRUCTURE SUITED FOR LARGE TOROIDAL EXPERIMENTS. Lallia, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1974. 6p. (CONF-740642-4). Dep. NTIS (US Sales Only) $4.00.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In reactor oriented devices, like Tokamaks or Stellarators ($ne > 5 \times 10^{13}$ cm^{-3}, B ≃ 30 to 40 kG on the axis), the low hybrid resonance frequency is ≃ 800 MHz, allowing a waveguide attack. However, the "accessibility" condition requires slowing down the wave parallel to $\vec{B}$, which is usually produced by some mechanical structure located between the plasma and the vacuum wall. A new structure is described consisting of a compact set of properly phased waveguides, called "Grill," which is able to launch effectively a slow wave to the plasma without reducing the useful cross section of the liner. (auth)

22171 (EUR-5182e, pp 119-126) OHMIC HEATING AND VERTICAL FIELD COIL SYSTEMS OF W VII. Jaenicke, R.; Kunze, R. C.; Lohnert, H.; Mueller, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

For ohmic heating (OH) experiments the W VII stellarator is equipped with an air-core transformer which can produce a magnetic flux of about 2.9 Vs. The magnetic fields in the plasma region are kept below 5 G. The fast flux variation required for heating the plasma is produced by forcing the current in the coils into a large parallel resistor by opening a HVDC breaker. Since the plasma current has long pulse lengths of the order of one second, the W VII needs a vertical magnetic field for equilibrium. This field is produced with coils mounted outside the toroidal field coils. Power is supplied by the OH coils operating as in inductive energy storage system. The field distribution and field amplitude of the vertical field can be varied by varying the number of turns in the individual coils. (auth)

22172 (EUR-5182e, pp 423-431) ENGINEERING ASPECTS OF A NEUTRAL INJECTION SYSTEM FOR TOROIDAL PLASMA EXPERIMENTS. Cowlin, M. L.; Aldcroft, D. A.; Burcham, J. N.; Cole, H. C.; Hemsworth, R. S.; Sheffield, J. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A high energy neutral injection system which will be used for providing additional heating of the plasma, has been developed and tested on CLEO Tokamak. The engineering of the system is described, together with the modifications required to the injector lines and their controls, to improve the performance for installation on CLEO Stellarator and DITE Tokamak. (auth)

22173 (IPP-1/151) HYBRID FLUID-PARTICLE MODEL FOR THE DESCRIPTION OF ION HEATING IN HIGH MACH NUMBER SHOCK WAVES. Chodura, R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

A hybrid model treating electrons as a dissipative fluid and ions as particles is used to investigate numerically the properties of high Mach number magnetoacoustic shock waves propagating perpendicular to a magnetic field. Increasing the Alfvén Mach number M_A electron pressure behind the shock becomes bounded for $M_A \gtrsim 15$. Ion reflectivity α increases but stays rather small even for $M_A \to \infty$, $B_0 \to 0$ (i.e., $\alpha = 30 - 40\%$ for reasonable collision frequencies in the shock). Thermalization of the shock by multiple bouncing in a cylindrical tube is studied for the case where the ion gyro-radii are large compared to the tube radius. Strong damping is found leading to equilibration after about two bounce oscillations. Ion reflection during first implosion is found to be essentially for non-adiabatic ion heating in the succeeding thermalization period. (auth)

22174 (IPP-IV-78) GRAZING INCIDENCE COUPLING TO THE LOWER-HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

The boundary value problem of "grazing incidence" coupling to the lower-hybrid resonance is studied under idealized conditions. It is found that in addition to the $n_z \simeq 1$ (n_z is the longitudinal refractive index) mode, a significant fraction of the incident energy is coupled to a slow wave, thereby greatly enhancing the plasma penetration by the radio frequency wave. The slow mode exists as an eigensolution of the waveguide formed between the metallic wall and the reactive surface impedance of the plasma. The slow wave is sufficiently retarded to permit accessibility to the lower-hybrid resonance for any foreseeable low-β experiment. The "grazing incidence" approach thus combines the advantages of accessibility as well as matching without having to construct any extensive structure within the machine walls. (auth)

22175 (IYAF-74-79) DIFFUSION OF HEAVY IMPURITIES IN DENSE PLASMA. Vekshtein, G. E.; Ryutov, D. D.; Chebotaev, P. Z. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Since even small additions of multiply charged ions can strongly accelerate the bremsstrahlung loss from plasma, for the determination of the energy lifetime of the plasma it is necessary to know the penetration depth of heavy impurities and their density distribution in the plasma. A theoretical study is made of this problem. The radial dependence of the plasma parameters at the moment of time $t = 2.1 \times 10^{-5}$ sec and the effective velocity and density distribution of heavy particles with $Z = 3$ and $Z = 10$ are calculated. The results show that although the impurity density has a sharp maximum in the boundary layer, their penetration into the plasma is small. Therefore, the contamination of plasma with impurities is not a basic danger. (JSR)

22176 (KHFTI-74-37) ELECTROSTATIC AND ELECTROMAGNETIC TRAPS FOR HIGH-TEMPERATURE PLASMA. Lavrent'ev, O. A. (AN Ukrainskoj SSR, Kharkov, Fiziko-Tekhnicheskij Inst.). 1974. 39p. (In Russian). Dep. NTIS (US Sales Only) $5.00.

The theoretical and experimental aspects of high-temperature plasma heat insulation in systems with electrostatic as well as electric and magnetic fields are considered. The definite types of traps, diagnostic methods, and the fundamental experimental results are given. (auth)

22177 (NP-20297) ESTIMATION OF THE HEATING EFFICIENCY OF VISCOUS HOT PLASMA COLUMN AT MAGNETOACOUSTIC OSCILLATIONS. Roife, I. M. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Oscillation Q-factors for a viscous hot plasma column undergoing magnetoacoustic oscillations are derived using a one fluid model. The conditions for the largest ion heating near $\beta_0 = 1$ are determined. (auth)

22178 (ORNL-TM-4772) PLASMA CRITERIA FOR A LOW-IMPURITY, CIRCULAR TOKAMAK. Hogan, J. T. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. W-7405-eng-26. 50p. Dep. NTIS $5.50.

The development of criteria for plasma transport and injection scaling requirements of power-producing systems is summarized. It has been produced as part of a larger study at ORNL aimed at establishing the optimal parameters for a tokamak device which could address both technological and physics questions. The key technological elements are superconducting magnets and high current neutral beams. The physics questions are centered around the handling of large energy fluxes in a way which minimizes impurity production in experiments with pulse times much longer than an energy confinement time. Each of these objectives will impose its own constraints, and the purpose of this report is to

examine those imposed by the requirement that the experiment be relevant to questions of impurity control and injection scaling. (auth)

22179 (SAND-74-6022) HIGH POWER RELATIVISTIC ELECTRON BEAMS IN PLASMA AND IN VACUUM. Breizman, B. N.; Ryutov, D. D. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1974. Translated by P. E. Newman from Preprint 119-74. 127p. Dep. NTIS $9.50.

The possibilities of using high power relativistic electron beams for plasma heating in open systems are discussed. The following three groups of questions are considered: (1) beam transport in a vacuum in a strong magnetic field, equilibrium, stability, and critical beam currents in vacuum; (2) beam transport in plasma, charge and current neutralization of the beam; plasma heating by a reverse current, macroscopic beam instabilities in plasma; and (3) theory of collective beam relaxation in plasma, including quasi-linear and nonlinear relaxation models; the role of plasma instability; macroscopic effects during beam relaxation. The review encompasses results published up to September 1973. (auth)

22180 (SFTI-6) EFFECT OF VARIABLE ELECTRICAL FIELDS ON THE MOVEMENT OF CHARGED PARTICLES IN A TOROIDAL TRAP WITH SPIRAL MAGNETIC FIELD. Demirkhanov, R. A.; Stotland, M. A.; Khil, Sh. V.; Baratov, D. G.; Mikava, L. V.; Ustyuzhaninov, V. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi. Fiziko-Tekhnicheskij Inst.). 1974. 57p. (In Russian). Dep. NTIS (US Sales Only) $6.00.

The results of the analytical and numerical calculation of the movement of charged particles in a toroidal spiral magnetic field in the presence of an alternating electrical field are reported. The interaction of the trapped charged particle with the variable electrical field is examined in detail. The conditions under which the trapped particles can be converted into runaway particles were determined. The results of the numerical calculation of the movement of particles in the magnetic field of a circular double stellarator in the absence of an electrical field are also reported. (tr-auth)

22181 ELECTRON BEAM HEATING OF A FREE JET GAS TARGET. Robinson, J. E.; Haasz, A. A.; Deleeuw, J. H.; Stangeby, P. C. (Toronto Univ., Ontario (Canada). Inst. for Aerospace Studies). Nucl. Instrum. Methods; 121: No. 2, 287-296(15 Oct 1974).

A $\frac{1}{400}$th scale laboratory experiment has been constructed to investigate the tritium-deuterium ion beam-gas target interaction of proposed intense 14-MeV neutron generators for fusion reactor studies. A keV electron beam mounted in a low density wind tunnel is used to simulate the gas heating near the sonic surface of a free-jet. The experimental method is described and results for the heating of helium, argon, and nitrogen gas flows are presented. (auth)

22182 NONLINEAR THEORY OF THE HIGH-FREQUENCY HEATING OF PLASMA. Ivanov, A. A.; Sigov, Yu. S.; Khodyrev, Yu. V. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR; 214: No. 6, 1291-1294(21 Feb 1974). (In Russian).

The collective processes during the interaction of a plasma with a strong electromagnetic field were studied in the framework of one-dimensional numerical experiments. The solution was made at the first moment when the pumping wave was introduced. The results show that intensive heating of the electrons begins when a certain level of electrostatic noise is reached. In all the variations considered on the initial stage of the process of nonlinear scattering of the Langmuir oscillations on ions, the ions are less effectively heated than the quasilinear heating of electrons with a wide spectra of Langmuir oscillations. The condition $T_e \gg T_i$ is generally the character of the high-frequency heating of plasma. The value of the wave number of the oscillations decreases with the increase of the electron temperature. (JSR)

22183 ELECTRON CONFINEMENT MEASUREMENTS ON THE ORMAK PLASMA USING THOMSON SCATTERING. Murakami, M.; Wing, W. R.; Edmonds, P. H. (Oak Ridge National Lab., TN). Nucl. Fusion; 14: No. 6, 779-787(Dec 1974).

Measurements were made of electron temperatures in the Oak Ridge Tokamak, ORMAK, using Thomson-scattered light from a Q-switched ruby laser. The measurements described were made during spring 1973. The measured electron temperature ranges from 0.20 to 1.2 keV for average electron densities of 1×10^{13} to 3×10^{13} cm^{-3}. The radial electron temperature profiles observed in stable discharged are broad (flat over about $\frac{1}{2}$ the limiter radius), while a tendency towards sharpened profiles appears when the discharges become unstable at low safety factor. In these measurements β_p (plasma kinetic pressure/poloidal magnetic field pressure) is observed to vary as $\bar{n}_e/I$, and the resistivity enhancement (experimental resistivity/Spitzer resistivity) as, at a constant current, $1/\bar{n}_e$. An empirical expression for the energy confinement time is discussed. (auth)

22184 ION-CYCLOTRON HEATING EXPERIMENTS ON THE HELIOTRON-D. Iiyoshi, A.; Sato, M.; Sasaki, A.; Obiki, T.; Uo, K. (Kyoto Univ., Uji, Japan). Nucl. Fusion; 14: No. 6, 789-792(Dec 1974).

Ion-cyclotron resonance heating experiments in the toroidal plasma of the Heliotron-D are described. The magnetic configuration used has a fairly strong helical inhomogeneity with a large rotational transform angle and shear. An appreciable ion temperature increase is observed from measurements of the Doppler line width of He-II at a 100 kW rf power level. A comparison study with other devices is described for a scaling of the ion-cyclotron resonance heating in present toroidal plasma. (auth)

22185 EQUILIBRIA AND ADIABATIC COMPRESSION OF FREE-BOUNDARY BELT PINCHES. Kadish, A.; Stevens, D. C. (New York Univ., NY). Nucl. Fusion; 14: No. 6, 821-829(Dec 1974).

The plasma shape and location of a sharp boundary belt pinch is determined by the dimensions of the surrounding conducting shell and by thermodynamic parameters. It is shown that, except for simple scaling, there exists a one-parameter family of equilibria. The plasma shape is uniquely determined by initial parameters and wall current. The variation of the plasma shape during an adiabatic compression is calculated, as are plasma current, temperature, field strength, etc. As the compression ratio of the plasma is increased beyond two, the ratio of plasma height/width decreases to unity. For high compression ratios, the column cross-section becomes circular. Explicit solutions are obtained by conformal mapping. (auth)

22186 CONFINEMENT OF PLASMA IN THE DOUBLET-II DEVICE. Jensen, T.H.; Fisher, R.K.; Hsieh, C.L.; Mahdavi, M.A.; Vanek, V.; Ohkawa, T. (General Atomic Company, San Diego, California 92138). Phys. Rev. Lett. 34: No. 5, 257-260 (3 Feb 1975).

Doublet II is a noncircular cross-section toroidal device with three magnetic axes. Theoretical considerations show that confinement of plasma in a doublet device might be similar to that of a tokamak with a much stronger toroidal magnetic field. Experiments carried out in Doublet II verify this in that the plasmas are found to have densities, temperatures, q values, and confinement properties close to those of comparable circular-cross-section tokamak plasmas. (auth)

22187 NONAXISYMMETRIC EQUILIBRIA IN TOKAMAKS AND OHMICALLY HEATED STELLARATORS. Lo Surdo, C.; Sestero, A. (Laboratorio Gas Ionizzati (Assn. CNEN-Euratom), Frascati, Italy). Phys. Fluids 18: No. 2, 255-262 (Feb 1975).

An asymptotic expansion scheme is set up, which is appropriate to deal with the deviations from axisymmetry occurring in tokamaks and Ohmically heated stellarators. Solutions of the magnetohydrostatic equations are sought to all orders in the expansion parameter, which is related both to the magnitude of the deviations from axisymmetry and to the ratio of poloidal vs toroidal components of current and magnetic field. Arguments are presented for the existence of the solution to any finite order, the pressure and current profiles across the plasma column, in general, being determined by the nonaxisymmetric part of the external magnetic field. If the latter, however, has certain symmetries, then a degeneracy occurs, and the pressure and current profiles can again be given with some degree of arbitrariness. It is shown that for tokamaks and stellarators of standard design, viz., including the perturbations associated with the "ripples" in the toroidal field, the "gaps" in the copper shell, and the helical windings, the degree of arbitrariness in the pressure and current profiles is the same as in the axisymmetric theory. Thus, in such machines the above profiles are expected to be governed entirely by transport effects, a conclusion which is borne out by the experiments. (auth)

22188 PUMP-OUT IN TRANSIT-TIME MAGNETIC PUMPING OF STELLARATORS. Shohet, J.L. (The University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. Lett. 34: No. 6, 310-312 (10 Feb 1975).

Transit-time magnetic pumping (TTMP) in stellarators has been attempted experimentally with the result that enhanced plasma pump-out occurs. This pump-out may be explained by conversion of trapped particles to circulating particles by TTMP outside of the separatrix. This occurs for trapped particles because the bounce frequency is of the order of the TTMP driving frequency. (auth)

Plasma Diagnostics

22189 (EUR-5182e, pp 465-469) CURRENT COMPOSITION AND OBJECTIVES OF THE EURATOM DATA ACQUISITION COORDINATING COMMITTEE (DACC). Read, A. H. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The DACC was set up in December 1973 primarily to advise the Committee of Directors and the various Advisory Groups on the equipment (both hardware and software) to be purchased for the acquisition and processing of data obtained from experiments within the European Fusion Program. The present structure of the DACC and the directions in which its work is developing are outlined. (auth)

22190 (EUR-5182e, pp 471-476) DATA PROCESSING FOR THE TFR EXPERIMENT. Gourdon, C.; Hennion, F.; Touche, J. (CEA, Fontenay-aux-Roses, France). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The collection, storage and processing of the experimental measurements on TFR are made with a T2000 computer (Télémécanique Electrique). The real-time system which has been developed to perform this task is described. A brief description is given of the various data acquisition systems. (auth)

22191 (EUR-5182e, pp 477-484) DATA ACQUISITION OF SPICA. Kooijman, W. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

SPICA is a fast toroidal screw-pinch experiment; the duration of the discharge is typically 100 μs to 1 ms. Since the data have to be stored within this time, fast AD-converters with local memory are used. The experiment also requires fast interpretation of the signals. Therefore, programs were developed to facilitate the communication between experimentalist and computer. The slow data coming from the experiment are the settings of the digital timer and the initial conditions of SPICA, e.g., bank voltages and pressure. The fast data come mainly from magnetic pick-up coils. These signals are digitally stored. Read-in programs give an output on a data sheet and transfer all the data, including the remarks, to the computer. The main program is interactive, which means that it calls for an instruction, identifies this instruction and transfers it to the right subroutine, which then executes the instruction. This program is written in the machine-language of the PDP-15. All the subroutines are written in FORTRAN or machine language. The main program makes it possible to execute instructions which perform the following operations: multiply, add, subtract, divide, integrate, plot on display or plotter, read on or write from any peripheral. It is also possible to reduce a set of instructions to one short instruction. Furthermore, experiment-depending instructions can be easily built in. (auth)

22192 (EUR-5182e, pp 485-487) SURVEY OF THE RODAS SYSTEM. van der Heiden, T. C. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

RODAS (Rijnhuizen On-line Data Acquisition System) has been designed for the handling of data produced by diagnostic systems of plasma physics experiments. The central computer has been connected with the SPICA screw pinch experiment via an optically coupled CAMAC branch highway. Real time data storage into the central computer memory is difficult, due to the high conversion rate (10 samples per μs) and the noise generated by the discharge of the SPICA capacitor banks. The analog signals are converted into 6 bit digital words and assembled into 256 word shift registers. Between two shots the information of the shift registers is sent to the central computer. For the communication between computer and experiment a fast typewriter has been interfaced to the branch highway at the experimental site. This typewriter has the same facilities as the console teletype. A storage display is also coupled via the branch highway so that graphs can be visualized locally. (auth)

22193 (EUR-5182e, pp 489-494) TREATMENT AND STORAGE OF DATA WITH A PDP 8E. Busser, J. J. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A PDP 8E computer interfaced with a CAMAC crate is used for the handling of data produced by diagnostic systems of the Ringboog experiment. The analogue signals are converted into digital words and assembled into shift registers up to 512 words. Between two shots the information of the shift registers is sent to the computer via the CAMAC crate. The main task of the machine is to store and assemble the data from successive shots. The interactive language FOCAL-8 is modified to handle the peripheral equipments CAMAC and display units, and for large data storage in arrays. This has been done in a paper tape version; a magnetic tape version is under construction. (auth)

22194 (EUR-5182e, pp 519-538) CAMAC AND ITS APPLICATION IN PLASMA PHYSICS. Hopmann, W. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The principles of CAMAC, a modular instrumentation system for data handling are outlined. The specifications of this system as approved by the ESONE Committee are covering the demands for on-line data acquisition for plasma physics experiments. These and the problems of application are discussed. (auth)

22195 (IPP-4/125) INTERFEROMETRIC DENSITY MEASUREMENTS BY A CO_2-LASER AT A LASER PRODUCED PLASMA. Buechl, K.; Haering, T. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 62p. (In German). Dep. NTIS (US Sales Only) $6.25.

The expansion of a CO_2-laser produced plasma from a polyethylene pellet of 200 μ diameter was investigated using a Mach–Zehnder-interferometer at 10.6 μ. The expansion is asymmetric towards the laser. The measured density profiles are compared with calculated profiles. About 10% of the pellet atoms are ionized. Only a very small portion of the laser energy has been found in the produced plasma. (auth)

22196 (UCRL-75923) ULTRAFAST X-RAY STREAK CAMERA. Coleman, L. W.; McConaghy, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Aug 1974. 8p. (CONF-740915-3). Dep. NTIS $4.00.

From 11th international congress on high speed photography; London, UK (15 Sep 1974).

A unique ultrafast x-ray sensitive streak camera, with a time resolution of 50 psec, was built and operated. A 100 Å thick gold photocathode on a beryllium vacuum window is used in a modified commercial image converter tube. The x-ray streak camera was used in experiments to observe time resolved emission from laser-produced plasmas. (auth)

22197 DIAGNOSTICS OF AN ORGANIC VAPOUR PLASMA BY IMPEDANCE MEASUREMENTS OF A SPHERICAL PROBE. Henry, D.; Jan, M.; Treguier, J. P.; Vuillermoz, B. (Centre National d'Etudes des Telecommunications (CNET), Centre de Recherches de Lannion, 22 (France)). Phys. Lett., A; 50: No. 2, 113-114(18 Nov 1974). (In French).

In situ diagnostics have been performed in a chemical plasma used for polymerization. Impedance measurements of a spherical probe immersed in the plasma have allowed the determination of the radial distribution of electron density and the evaluation of electronic temperature. (auth)

22198 PLASMA DENSITY MEASUREMENTS BY ELECTRON–PLASMA WAVE PULSES IN A Q-MACHINE. Sugai, H.; Merk, E. (Innsbruck Univ., Austria). J. Phys., D (London); 7: No. 16, 2198-2204(1 Nov 1974).

An accurate determination of plasma densities in a Q-machine can be given by observations of electron-plasma wave pulses. A universal chart to evaluate the plasma density from the propagation speed of wave pulses is provided. It is shown that the radial density distribution should be taken into account in this diagnostic method. Comparison between this method and Langmuir probe methods is presented. It is concluded that speed measurements of electron-plasma wave pulses offer a rapid reliable method for determining the density of a low-density plasma (10^6 to 10^9 cm^{-3}). (auth)

22199 EFFECT OF COLLISIONS ON POSITIVE ION COLLECTION BY A CYLINDRICAL LANGMUIR PROBE. Zakrzewski, Z.; Kopiczynski, T. (Inst. of Fluid-Flow Machines, Danzig). Plasma Phys.; 16: No. 12, 1195-1198(Dec 1974).

Preliminary results of experiments on ion collection by a cylindrical probe in a plasma at rest are presented. The influence of ion-neutral collisions on the value of normalized ion current in general in terms of the reduced probe radius, and the collision parameter is given. (UK)

22200 ION COLLECTION BY CYLINDRICAL LANGMUIR PROBES IN A STRONG AXIAL MAGNETIC FIELD. Williams, J. A. (Southampton Univ., Eng.). J. Phys., D (London); 7: No. 16, 2205-2217(1 Nov 1974).

Cylindrical Langmuir probes were used to obtain information from a potassium plasma generated in a single-ended Q-machine. The results showed the variation of probe current i_p with mag-

netic field strength B and were compared with the predictions of a collisionless theory. The best agreement was obtained at low plasma densities (~10^{14} m^{-3}) when utilizing a sheath thickness which was dependent upon the dimensionless parameters $\xi = r_p/\lambda_p$ and $\eta = e\varphi/kT$. Poorer agreement was observed in the density region above ~10^{16} m^{-3} and was attributed to the collisionless assumption. The effects of variation in probe bias and probe size were in keeping with the theoretical predictions. Calculation of the plasma density was obtained by an iterative method and compared favorably with predictions from Laframboise's results (UTIAS Rep. No. 100(1966)). (auth)

22201 TWO-WAVELENGTH HOLOGRAPHY FOR MEASURING PLASMA ELECTRON DENSITY. Radley, R.J. Jr. (General Research Corporation, Washington Operations, McLean, Virginia 22101). Phys. Fluids 18: No. 2, 175-179 (Feb 1975).

The spatial distribution of free electrons in a stationary, cw, laser-produced air plasma has been measured using single-pulse, two-wavelength holographic interferometry. This measuring technique provided a noncontact method of directly measuring electron density uninfluenced by the other plasma constituents. The general theoretical basis for this type of two-wavelength holography and its application to ionized gases are discussed. Also described are the experimental methods used to implement the technique. Interferograms of the plasma were made at two laser input powers: 3500 W and 6200 W. The electron density was measured as a function of radius and axial position in the plasma, which was oriented vertically to insure cylindrical symmetry. The range of measured values was 10^{16}-10^{17} electrons/cm^3 for diameters ranging from 0.2 to 0.8 cm. (auth)

22202 EXPERIMENTAL STUDIES OF THE PLASMA FOCUS AND EVIDENCE FOR NONTHERMAL PROCESSES. Bernard, A.; Coudeville, A.; Jolas, A.; Launspach, J.; de Mascureau, J. (Commissariat a` l'Energie Atomique, Centre d'Etudes de Limeil, 94190-Villeneuve-Saint-Georges, France). Phys. Fluids 18: No. 2, 180-194 (Feb 1975).

A systematic experimental study is conducted in order to measure the density and configuration of the plasma by holographic interferometry, and the ion temperature and level of turbulence by cooperative laser scattering. The two measurements are done in various phases of the plasma, before, during, and after the filament breakup. Suprathermal scattering during the filament phase and the successive development of an ionizing wave are evidenced for the first time. The anisotropy of the neutron emission is found to exist in all regimes by the simultaneous measurement of the energy spectra in two directions. A possible explanation of the neutron emission is given. It is concluded that nonthermal processes play an essential role in the plasma focus. (auth)

22203 FARADAY-ROTATION MEASUREMENTS OF MEGAGAUSS MAGNETIC FIELDS IN LASER-PRODUCED PLASMAS. Stamper, J.A.; Ripin, B.H. (Naval Research Laboratory, Washington, D. C. 20375). Phys. Rev. Lett. 34: No. 3, 138-141 (20 Jan 1975).

Magnetic fields in the megagauss range have been observed in the laser-produced plasma near the focus of a high-power laser pulse. Faraday-rotation measurements utilizing the light of a probing beam and the specularly reflected laser light both show the presence of these large fields. (auth)

22204 EFFECT OF THE ELECTRON ENERGY DISTRIBUTION ON ION PROBE CHARACTERISTICS. Vasil'eva, I.A. (Institute of High Temperatures, Academy of Sciences of the USSR). High Temp. 12: No. 3, 405-412 (Jan 1975).

The effect of the form of the electron energy distribution on the ion probe current is studied. It is shown that a change in the form of the electron energy distribution redistributes the potential near the probe and changes the ion current. It is established that changes in the electron distribution function which lead to a sharper drop in electron density in a repulsive field decrease the ion current. (auth)

22205 MEASUREMENT OF PLASMA DENSITY BY A SUBMILLIMETER LASER. Malykh, N.I.; Yampol'skii, E.S.; Malykh, L.Y.; Tarasevich, A.I. (Physicotechnical Institute, Sukhumi). High Temp. 12: No. 3, 422-425 (Jan 1975).

A measuring system with a three-mirror laser interferometer (0.337 mm) is described. The detector is a pair of InSb-beryllium bronze crystals operating at room temperature. The density in an operating plasma device is obtained from oscilloscope traces. The system measures plasma densities ranging from $2 \cdot 10^{12}$ to 10^{16} cm^{-3} for an 80-mm plasma diameter. (auth)

22206 GENERATOR THAT PRODUCES GROUPS OF SHORT RECTANGULAR PULSES OF HIGH AMPLITUDE. Williams, A. P.; Skubko, V. A.; Krasnyi, V. V. (Inst. of Physics and Tech., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1035-1036(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 86-88(1974).

A generator is described which produces groups of powerful rectangular pulses of positive polarity and high amplitude and is designed for performing experiments with a plasma. (auth)

Plasma Kinetics (General)

Refer also to abstract 22188.

22207 (AE-501) ELECTROMAGNETIC SCREENING AND SKIN-CURRENT DISTRIBUTION WITH MAGNETIC AND NON-MAGNETIC CONDUCTORS. Dahlberg, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

In many applications it is permissible to assume that eddy currents are essentially confined to the skin of the conductor. However, the perfect-conductor approach, commonly employed for skin-current estimates, requires that also $\mu d \ll L_t$, where μ is the relative permeability of the conductor, d its skin depth, and L_t a characteristic length along its surface. The need for this restriction does not seem to be sufficiently well known. Simple formulas giving quantitative estimates-valid for arbitrary $\mu d/L_t$-for far-field skin-currents, eddy-current losses and screening efficiency are derived for several simple configurations. Boundary conditions that should allow calculations for more complicated configurations are also presented. The parameter μd is important also for nonmagnetic materials. Thus, the equivalence of a thin real screen (thickness D) and an infinitely thin screen with the same $\sigma\omega D$ will be improved if-in addition-μd is the same for both. (auth)

22208 (CLM-R-137) ANALYTIC EXPRESSIONS FOR SELECTED CROSS-SECTIONS AND MAXWELLIAN RATE COEFFICIENTS. Freeman, R. L.; Jones, E. M. (UKAEA Research Group, Abingdon, Culham Lab.). May 1974. 43p. Dep. NTIS (US Sales Only) $5.25. £1.00.

Convenient analytic expressions have been obtained for the cross sections and the Maxwellian rate coefficients for electron ionization, proton ionization, and proton charge exchange. These expressions were obtained for atomic and molecular hydrogen, the alkali metals, the rare gases, calcium and magnesium. The rates for these same processes have been evaluated for 5 and 10 keV atomic hydrogen beams in atomic hydrogen. The experimental values for the ionization and charge exchange cross sections were fitted either by the analytic expressions of Gryzinski (Phys. Rev.; 138:A 305 (1965)) or by a polynomial, and these analytic expressions were then used for integration over a Maxwellian velocity distribution. The values of the rate coefficients were fitted in selected cases with a polynomial and the coefficients for this polynomial are tabulated. Plots of the analytic fits to the experimental cross sections and the Maxwellian rate coefficients are given in each case. (auth)

22209 (IPP-6/129) STIMULATED RAMAN SCATTERING FROM PLASMAS IRRADIATED BY NORMALLY AND OBLIQUELY INCIDENT LASER LIGHT. Biskamp, D.; Welter, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

The frequency spectrum and the angular distribution of the scattered light, and the absorption coefficient, due to stimulated Raman scattering are obtained by extensive numerical simulations of one and two-dimensional plane plasma targets irradiated normally or obliquely by high-power laser light. Theoretical models are given to explain the numerical results. (auth)

22210 (IYAF-74-80) RECOMBINATION MECHANISM OF THE HEAT CONDUCTIVITY OF A PLASMA IN A STRONG MAGNETIC FIELD. Vekshtein, G. E.; Ryutov, D. D. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Even in high-temperature plasma there are always neutral H atoms formed as a result of recombination. Since a magnetic field does not affect the movement of these atoms, a transfer mechanism arises which does not depend on the direction of the magnetic field. This mechanism determines the lower limits of the transfer coefficient attainable in a sufficiently strong magnetic field. This transfer coefficient is calculated in the present study. It is shown that a recombination mechanism exists even in quite moderate magnetic fields. (JSR)

22211 MOBILITIES OF H^+ AND D^+ IONS IN NEON GAS. Orient, O. J. (Polytechnical Univ., Budapest). J. Phys., D (London); 7: No. 16, 2266-2268(1 Nov 1974).

The mobilities of mass-identified H^+ and D^+ ions in neon were measured with a drift-tube quadrupole mass spectrometer at 300°K. The reduced zero-field mobilities of H^+ and D^+ ions, corrected to 273°K are 22.3 ± 0.22 and 16.1 ± 0.16 cm^2 V^{-1} s^{-1}. The neon gas pressure in the mobility tube was in the range 3.1

to 5.3 torr and the hydrogen as well as the deuterium gas concentration was about 0.01%. H^+ and D^+ were produced from the gas mixture by a DC glow discharge. The measurement results compared with the values calculated from Langevin's polarization limiting theory (Ann. Chem. Phys.; 8: 245(1905)) showed a deviation of 3.2% in the case of H^+ and that of 3.5% in the case of D^+. (auth)

22212 COMPUTER EXPERIMENTS ON CLUMP FORMATION IN PLASMA. Hui, B.H.; Dupree, T.H. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Fluids 18: No. 2, 235-242 (Feb 1975).

Phase–space density granulations called clumps are simulated by computer experiments. The experimental results compare well with the theoretical predictions. In particular, we show that these clumps can be as large as the linear response. The criteria for steady–state clump turbulence are also examined numerically. (auth)

22213 APERTURE DISTORTIONS OF THE SPECTRAL COMPOSITION OF LIGHT SCATTERED AT SMALL ANGLES BY THE ELECTRODES OF A PLASMA. Pyatnitskii, L.N.; Grinberg, I.V.; Chebanov, V.P. (High–Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 3, 509-514 (Jan 1975).

An expression is obtained for the spectral distribution of light scattered by the electrodes of a plasma, in which account is taken of aperture distortions of the light when it is observed at small angles. A method is proposed for integrating this expression in an electronic computer, and the results of the integration are described. Nomograms are given for determing the parameters of the plasma from experimental results for the scattering angles 2.5°, 5°, 10°, and different apertures. (auth)

22214 DEPARTURE FROM LTE AND EMISSION IN A LOW DENSITY RECOMBINING OXYGEN PLASMA. Julienne, P. S.; Oran, E. S.; Davis, J. (Naval Research Lab., Washington, DC). J. Phys., B (London); 7: No. 15, 2100-2111(21 Oct 1974).

A radiative cascade model is used to calculate the excited state population densities of a recombining oxygen plasma. The model is expected to be valid for the low quantum number S, P, and D levels for electron densities below around 10^6 cm^3. The radiative recombination coefficients for the S, P, and D series and the Einstein A coefficients for transitions between members of these series are calculated by the quantum defect method. All levels with $l \geq 3$ are taken to be hydrogenic. The excited state densities are found for the two limiting cases in which the transitions to the ground state are either optically thin or optically thick. The emission line intensities from cascading are calculated. (auth)

22215 SPECTROSCOPIC STUDY OF THE RECOMBINATION OF C^{6+} TO C^{5+} IN AN EXPANDING LASER-PRODUCED PLASMA. Irons, F. E.; Peacock, N. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., B (London); 7: No. 15, 2084-2099(21 Oct 1974).

The Lyman spectrum of carbon VI from the expansion plume of a laser-produced plasma has been interpreted to give the absolute distribution of electrons amongst bound and free energy states. Local thermal equilibrium is shown to be attained for bound states equal to and above a certain principal quantum number η which varies with the plasma parameters from $\eta \simeq 4$ at a distance of 1.0 mm from the target to $\eta \simeq 6$ at 2.8 mm. At 2.8 mm, excited states of principal quantum number 2 to 5 have an inverted population. Plasma densities ($N_e \simeq 4$ to 0.2×10^{18} cm^{-3}) and temperatures ($T_e \simeq 38$ to 9 eV) have been deduced from spectral intensities at distances of 1.0 to 2.8 mm from the target. Spectral intensities have also been interpreted in conjunction with plasma parameters and certain theoretical de-excitation rate coefficients to give the (collisional-radiative) recombination coefficient for the recombination of C^{6+} to the hydrogen-like C^{5+}, and this is compared with theory. The coefficient for purely two-body recombination to the ground state of C^{5+} has been deduced from the free-bound continuum intensity and is in good agreement with theory. With increasing distance from the target two-body recombination is seen to become progressively less important compared to three-body recombination, as is predicted by theory for an adiabatic expansion. Over the region 1.0 to 2.8 mm from the target, volume expansion and not recombination is shown to be the major cause of density decay, which is approximately adiabatic. (auth)

Plasma Kinetics (Experimental)

22216 RADIATION OF AN ARGON PLASMA AT TEMPERATURES OF 12,000–16,000°K. Kon'kov, A.A.; Kulagin, S.G. (High–Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 3, 426-430 (Jan 1975).

The spectral composition, the emissivity, and the absorption coefficients of an argon plasma are studied. The photoionization cross sections for atomic argon are measured in the 12,000–16,000°K range. (auth)

22217 MEASUREMENT OF ELECTRICAL CONDUCTIVITY OF NONIDEAL PLASMA AT 38,000°K AND PRESSURES (5–25) $\cdot 10^7$ N/m^2. Ogurtsova, N.N.; Podmoshenskii, I.V.; Smirnov, V.L. (Leningrad). High Temp. 12: No. 3, 559-561 (Jan 1975).

We have recorded the current–voltage characteristics of an evaporating–wall capillary discharge in order to determine the electrical conductivity of the resultant nonideal plasma.(AIP)

Plasma Kinetics (Theoretical)

22218 (COO-2218-19) FINITE ION TEMPERATURE EFFECTS IN TWO COMPONENT PLASMAS. Towner, H.; Miley, G. H.; Jassby, D.; Tenney, F. (Illinois Univ., Urbana (USA); Princeton Univ., N. J. (USA). Plasma Physics Lab.). 1974. Contract AT(11-1)-3073. 18p. (CONF-741079-5). Dep. NTIS $4.00.

From 16th annual meeting of the plasma physics division of the American Physical Society; Albuquerque, New Mexico, USA (28 Oct 1974).

Extending previous treatments that have assumed cold target ions, the influence of finite target-ion temperature on fusion energy multiplication Q for two-energy-component plasmas with and without energy clamping was studied. The increase in relative velocity, on the average, between beam and bulk ions results in reduced drag on the beam ions. A more significant effect is substantial change in fusion reactivity. For D on T, with $T_i \sim T_e$, Q is substantially increased over the cold-ion case provided that injection energy $W \lesssim 130$ keV; the improvement factor increases with decreasing W and can reach 40%, for example, at $W \approx 60$ keV, $T_e = T_i = 5$ keV. For $W \gtrsim 130$ keV, Q decreases slightly. In the case of energy clamping, the cross-over $W \sim 80$ keV. These results are especially significant at the end of a clamped, low-W burn, where additional fusion energy from the thermalizing suprathermal population is obtained. (auth)

22219 (COO-2218-22) EVALUATION OF CYCLOTRON RADIATION USING MONOENERGETIC ELECTRON GROUPS. Chu, T. C.; Miley, G. H. (Illinois Univ., Urbana (USA)). 1974. 14p. (CONF-741017-24). Dep. NTIS $4.00.

From meeting of the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

Calculations were performed in order to study cyclotron radiation emission for different electron groups in a uniform magnetic field and in cylindrical geometry. Special features of the calculations include: (1) intrinsic properties of the metallic reflector share equal status with the plasma parameters, (2) there is no explicit cut-off frequency involved in the calculations, and (3) relativistic effects are included such that the emission of relativistic electrons is evaluated explicitly. (MOW)

22220 (COO-2218-23) EFFECT OF DISPERSION IN ION SLOWING DOWN ON PLASMA ENERGY MULTIPLICATION FACTORS. Justiss, S. R.; Miley, G. H. (Illinois Univ., Urbana (USA)). 12 Dec 1974. Contract AT(11-1)-2218. 15p. Dep. NTIS $4.00.

The effects of dispersion in energy of hot ions slowing down in a plasma on the plasma energy multiplication factor are estimated. Numerical results are given for plasma parameters that are expected to be attained in the TCT device to be built at Princeton Plasma Physics Laboratory. The inclusion of this effect results in an increase in the plasma energy multiplication factor of order of ten percent or less, depending on the injection energy and target temperature. (auth)

22221 (IPP-2/222) ELONGATED FREE-BOUNDARY AXISYMMETRIC EQUILIBRIA. Barberio-Corsetti, P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). May 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The MHD equilibria of axially symmetric, current-carrying low-β plasmas with noncircular cross section are investigated. The appropriate boundary conditions are imposed by solving a self-consistent free-boundary problem in the approximation of a thin, vertically elongated, otherwise arbitrary cross section. The plasma boundary determines the external currents or vice versa. (auth)

22222 (JINR-E9-8225) COMPUTER SIMULATION OF DYNAMICS OF STRONG-NONLINEAR PHENOMENA DESCRIBED BY THE SCHROEDINGER EQUATION WITH THE SELFCONSISTENT POTENTIAL. Makhankov, V. G.; Bogolubskii, I. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

The results of a one-dimensional (plane, cylindrically and

spherically symmetric cases) computer investigation of the dynamics of a strong turbulence of Langmuir waves and whistlers are presented. (auth)

22223 (JUL-1108-TP) EFFECTIVE LEVEL SCHEMES FOR THE NEUTRAL COMPONENT OF A PLASMA. Helrich, C. S. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Technische Physik). Sep 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

A procedure is presented by which the level scheme of the neutral component of a plasma may be converted into an effective level scheme consisting of a small number of effective levels. Cesium under conditions of technological interest is treated as an example. (auth)

22224 (LBL-3317) COMPUTER-AIDED EXTRACTOR DESIGN. Cooper, W. S.; Halbach, K.; Magyary, S. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-eng-48. 10p. (CONF-741019-12). Dep. NTIS $4.00.

From symposium on ion sources and formation of ion beams; Berkeley, California, USA (22 Oct 1974).

A description is given of a computer program, WOLF, which simulates ion extraction from a plasma and acceleration through an electrode structure and optimizes the performance of the extractor (minimizes the final beam divergence) by varying the potentials, shapes, and positions of the electrodes. WOLF also finds the self-consistent shape and position of the plasma equipotential representing the emitter. The measured performance of our slot extractors agrees well with the computed performance based on our model for the plasma if the ions are assumed to have a temperature of about 1 eV at the emitter. The most important factors affecting the beam divergence are, in decreasing order of importance (1) gross electrostatic lens effects, including the space-charge of the ions, (2) the initial ion temperature, (3) the shape of the first, or "beam-forming", electrode, and (4) the shape and position of the plasma sheath edge, or emitter. (auth)

22225 (UCRL-75537(Rev.1)) LASER LIGHT ABSORPTION AND REFLECTION IN PLASMAS. Kruer, W.; Valeo, E.; Estabrook, K.; Thomson, J.; Langdon, B.; Lasinski, B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Oct 1974. 24p. (CONF-741105-53; IAEA-CN-33/F5-3). Dep. NTIS $4.25.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Mechanisms by which intense laser light energy is absorbed or reflected by a hot, dense plasma are of central concern in laser fusion studies. Extensive computer simulations show that the plasma waves responsible for absorption near the critical density are produced by instabilities, resonant excitation, and more generally by off-resonant coupling by nonlinearly produced ion density fluctuations. Nonlinear modifications in the plasma density profile are found to play a key role in the light absorption. DC magnetic fields large enough to affect electron transport are observed in computer simulations of intense obliquely incident light even in the absence of irradiation asymmetry. Finally, plasma heating near one-fourth the critical density and the role of bandwidth as a means to control Brillouin reflection are discussed. Classical inverse bremsstrahlung will efficiently absorb laser light intensities of order 10^{13}W/cm^2 (Nd). Such intensities are much less than those used in many pellet designs. At these higher intensities, laser light absorption (and reflection) can take place via the generation of plasma waves. Computer simulations are described for light absorption near the critical density, with particular emphasis on the role of self-consistent modifications of the density profile. Then the plasma heating near one-fourth the critical density and the use of bandwidth as a possible safety option to control Brillouin reflection is discussed. (auth)

22226 (UCRL-75761) SUMMARY OF THE RECENT LAWRENCE LIVERMORE LABORATORY (LLL) WORK ON THE EQUATION OF STATE OF DENSE MOLECULAR HYDROGEN. Ross, M.; Ree, F. H.; Keeler, R. N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Feb 1975. 9p. (CONF-741116-3). Dep. NTIS $4.00.

From 4th international conference on high pressure; Kyoto, Japan (25 Nov 1974).

Liquid deuterium was initially shock compressed by a two-stage gun to 210 kbars then reflected to 950 kbars. The final deuterium density was 7 to 8 times greater than that of the starting liquid. By using this data, along with earlier shock data on H_2 at 40 kbars and a 4°K isotherm to 25 kbars, it was possible to construct an equation of state for dense hydrogen using suitable theoretical models. The intermolecular potential was computed using the molecular orbital method and was found to be in poor agreement with the potential needed to fit the data. Since the disagreement might be due to the neglect of many body effects, calculations involving three molecules were undertaken. The effect of the third body was to considerably lower the energy and bring the theoretical and experimentally derived potential into satisfactory agreement. (auth)

22227 ANALYTICAL FORMULAE FOR THE INVERSE BREMSSTRAHLUNG ABSORPTION COEFFICIENT. Stallcop, J. R.; Billman, K. W. (National Aeronautics and Space Administration, Moffett Field, CA). Plasma Phys.; 16: No. 12, 1187-1189(Dec 1974).

Simple analytical expressions for calculating the electron-ion, free–free Gaunt factor for high electron temperatures ($\geq$1 eV/k) and long wave-lengths ($\geq$0.1 μm) are presented. The values of the Gaunt factor are displayed in a graphical form for wavelengths in the range 0.1–100 μm. (auth)

22228 EXACT SOLUTIONS OF TOROIDAL EQUILIBRIUM AND MHD STABILITIES. Oshiyama, H.; Fukutani, Y. (Kyoto Technical Univ.). Nucl. Fusion; 14: No. 6, 793-796(Dec 1974).

Exact solutions are given for an axisymmetric toroidal plasma equilibrium with rectangular cross section. The equilibrium configuration in which the current and the plasma pressure are zero at the boundary is examined by using the criterion of local stability. The equilibrium exists for large β, but its maximum value is limited by local instability. (auth)

22229 PROPERTIES AND SOLUTIONS OF THE STEADY-STATE NEOCLASSICAL TRANSPORT EQUATIONS. Conn, R. W.; Emmert, G. A. (Univ. of Wisconsin, Madison). Nucl. Fusion; 14: No. 6, 805-808(Dec 1974).

Some results on the properties and solutions of the steady-state form of the neoclassical transport equations are presented for regimes of interest to feasibility experiments and reactors. An analytical solution is obtained for the special case $dT/dr = 0$. For $dT/dr \neq 0$, an analytic solution is found for the particle density n(r) in terms of the current j(r) and the temperature T(r). For a prescribed j(r), a single differential equation remains to find the temperature profile. The numerical results suggest that neoclassical scaling does not admit self-sustained fusion plasma operation ($n \sim 10^{14}$/cm^3, $T \sim 10$ keV) except in plasmas of uninterestingly small sizes ($I_p < 500$ kA). (auth)

22230 CALCULATION OF THE TRANSPORT OF NEUTRAL ATOMS IN HIGHLY IONIZED PLASMAS USING NEUTRON TRANSPORT METHODS. Greenspan, E. (Princeton Univ., NJ). Nucl. Fusion; 14: No. 6, 771-778(Dec 1974).

The linear Boltzmann equation for the transport of neutral atoms in highly ionized plasmas is compared with the neutron transport equation. It is shown that, when the plasma is isotropic, the neutral transport equation can be solved with neutron transport methods. Two formulations of the neutral transport equation that are amenable to solution by existing multigroup neutron transport codes are given–the multigroup formulation and the multispecies approximation. In the first, the solution provides the neutral energy (as well as spatial and angular) distribution, whereas in the latter, the spectrum of each neutral species is assumed to be known and fixed. As an illustration, a problem of neutral penetration to and interaction with the plasma of the ST Tokamak is solved. The solution is obtained for a two-species model using the discrete ordinates code ANISN. (auth)

22231 NEOCLASSICAL TRANSPORT THEORY OF A TOROIDAL AXISYMMETRIC PLASMA WITH IMPURITIES. Dobrowolny, M. (Univ. L'Aquila, Italy); Nocentini, A. Nucl. Fusion; 14: No. 6, 831-840(Dec 1974).

The neoclassical transport theory of a toroidal plasma in the presence of ion impurities is investigated. In particular, referring to situations with hydrogen ions and electrons in the banana regime, the two possibilities, of the impurity ions being in the banana or in the plateau regime, are considered. It is found that, in the small aspect ratio limit and for practical values of impurity concentrations, the hydrogen ion diffusion across the magnetic field does not depend on the neoclassical regime of the impurities. (auth)

22232 ION EFFECTS IN RELATIVISTIC DIODES. Poukey, J.W. (Plasma Theory Division–5241, Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 26: No. 4, 145-146 (15 Feb 1975).

In relativistic diodes, ions are emitted from the anode plasma surface. The space charge of these ions enhances the electron emission. One–dimensional analysis and two–dimensional computer simulation are used to show the necessity of including this effect in any realistic diode theory. (auth)

22233 THEORY OF ENHANCED ION AND ELECTRON HEATING, AND DISSIPATION, DUE TO ION ACOUSTIC TURBULENCE. Weinstock, J.; Sleeper, A.M. (Aeronomy Laboratory,

National Oceanic and Atmospheric Administration, Boulder, Colorado 80302). Phys. Fluids 18: No. 2, 247-250 (Feb 1975).

A calculation is made of the enhanced ion heating rate ν_+, electron heating rate ν_-, and dissipation, produced by ion acoustic turbulence. The effects of turbulence on ion motions are accounted for. It is found that $\nu_+ > \nu_-$ for some experiments, leading to a decreasing ratio of electron to ion temperatures and cessation of heating. It is also shown that $\nu_+ \propto m_+^{-1/2}$ (ion mass). (auth)

22234 STIMULATED RAMAN SCATTERING FROM PLASMAS IRRADIATED BY NORMALLY AND OBLIQUELY INCIDENT LASER LIGHT. Biskamp, D.; Welter, H. (Max-Planck-Institut für Plasmaphysik, Garching, West Germany). Phys. Rev. Lett. 34: No. 6, 312-316 (10 Feb 1975).

The frequency spectrum and the angular distribution of the scattered light and the absorption coefficient due to stimulated Raman scattering are obtained by extensive numerical simulations of one- and two-dimensional plane plasma targets irradiated normally or obliquely by high-power laser light. Theoretical mdoels are given to explain the numerical results. (auth)

Plasma Production

Refer also to abstracts 22203, 22234, and 22489.

22235 (LA-5783-MS) IMPLOSION STABILITY, AND BURN OF MULTISHELL FUSION TARGETS. Fraley, G. S.; Gula, W. P.; Henderson, D. B.; McCrory, R. L.; Malone, R. C.; Mason, R. J.; Morse, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Various multishell laser/e-beam fusion pellets are described. These include a design with hollow fuel inside a high-Z pusher shell which gives greatly improved performance without extreme pulse shaping. The advantage of multishell, multimaterial pellets are discussed in general. Stability calculations then show that Taylor instability on both the inside and outside of shells can amplify perturbations with spherical harmonic l-numbers of the order of 100 by factors exceeding ten thousand. However, by decreasing shell aspect ratios ($r/\Delta r$) and intensifying the ablation rate these amplications can be greatly reduced. Acceptable instability growth seems attainable by using aspect ratios of the order of five or less and/or by operating in a less efficient exploding pusher mode. The effects of tamping by high-Z material on thermonuclear burn are briefly discussed. (auth)

22236 (UCID-16691) MULTI-MEGAJOULE SOFT X-RAYS FROM COMPRESSED ELECTRON LAYERS. Nowak, D. A.; Shearer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 May 1974. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

The compression of a ~10 MeV electron layer in a magnetic field by means of a capacitor bank or an imploding liner opens up a number of interesting possible applications. The possibility of increasing the energy of the electron layer by a factor of 5 to 10 could produce a multi-megajoule source of 50 to 100 MeV electrons — something not presently available. Such a compressed electron layer could radiate multi-megajoules of 100 eV to 1 keV soft x-ray photons. In addition, such an electron layer might be used as an energy source for relativistic electron beam pellet fusion. Various possible ways of accomplishing this latter application are still under discussion. (auth)

22237 (UCRL-13609) RADIATIVE EFFECTS ON THE PROPAGATION OF LASER-SUPPORTED DETONATION WAVES. Final Report, 9 April 1973-30 June 1974. Johnston, R. R. (Science Applications, Inc., La Jolla, Calif. (USA)). 1974. 212p. (SAI-072-624-PA). Dep. NTIS $13.75.

For Univ. of California, Livermore.

The laser absorption coefficient of air is described along with the basic radiative properties of air, opacities, emissivities, and absorption coefficients. A simple one-dimensional, stationary model was developed for describing LSD waves in air. Some electromagnetic propagation studies and calculations to investigate the applicability of geometric optics and weak reflection corrections are outlined. (MOW)

22238 (UCRL-75538) LASER DRIVEN IMPLOSION OF HOLLOW PELLETS. Nuckolls, J.; Lindl, J.; Mead, W.; Thiessen, A.; Wood, L.; Zimmerman, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1974. 12p. (CONF-741105-54; IAEA-CN-33/F5-4). Dep. NTIS $4.00.

From 5th conference on plasma physics and controlled nuclear fusion research; Tokyo, Japan (11 Nov 1974).

Implosion of hollow (rather than solid) pellets makes possible order of magnitude reductions in the required laser power and significant reductions in the required laser frequency. However, the symmetry and fluid instability problems are more severe in hollow pellet implosions. These problems have been calculated with the LASNEX two-dimensional multi-group energy transport magnetohydrodynamic computer program. Calculations show that laser driven implosions of moderately hollow pellets to the super dense Fermi degenerate states required for fusion power production are feasible when the laser power history is tailored to generate an optimum sequence of 5 to 10 weak shocks, the pellet is fabricated with a surface finish accurate to 10 to 100 Å and conditions previously described for solid pellets involving the laser wavelength and the initial atmosphere are satisfied. Excessive growth of fluid instabilities destroys implosions of thin walled hollow pellets driven by smoothly varying pulse shapes otherwise capable of generating the required isentropic high density states because the mean acceleration of the imploding shell is too small and because the ablation rate is not large enough to provide effective ablative stabilization. Calculations have also been made of laser driven implosions of complex hollow pellets containing one or more shells of high density, high Z materials (e.g., Fe or U). These pellets do not have high enough gain for laser fusion power production unless the laser efficiency is much greater than ten percent or unless the reactor is a hybrid (fission-fusion). (auth)

22239 A NEW HF DEVICE FOR THE PRODUCTION OF LONG PLASMA COLUMNS AT A HIGH ELECTRON DENSITY. Moisan, M.; Beaudry, C.; Leprince, P. (Montreal Univ., Quebec (Canada). Dept. of Physics). Phys. Lett., A; 50: No. 2, 125-126 (18 Nov 1974).

A new small HF device allows the production of a long electrodeless plasma column without magnetic field. A 25 mm diameter plasma with densities $10^{10} \sim 10^{11}/cm^3$ and length 1.80 m can be produced with 80 W at 500 MHz. (auth)

22240 LASER COMPRESSION OF MATTER: OPTICAL POWER AND ENERGY REQUIREMENTS. Kidder, R. E. (Univ. of California, Livermore). Nucl. Fusion; 14: No. 6, 797-803 (Dec 1974).

The optical power P_L required to achieve a given measure of inertial confinement ρR of a laser-compressed DT pellet is found to be approximately proportional to $(\rho R)^2$. This result is based on a model of self-regulating pellet ablation by hot electrons of the pellet corona that is relatively insensitive to the details of the pellet ablation process. To achieve values of ρR believed necessary in the application of laser fusion to commercial power production, 3×10^{15} W of optical power is found to be required, implying a total laser output aperture of 30 m^2. (The same power requirement would appear to apply to pellet compression by charged-particle beams.) An estimate of the required laser-pulse energy W_L, assuming corona-core decoupling to be the controlling limitation, is also given. In the application to commercial power production the required pulse energy is found to range from 70 kJ at 0.265 μm to 3 MJ at 10.6 μm. (auth)

22241 POWERFUL RELATIVISTIC ELECTRON BEAMS IN A PLASMA AND IN A VACUUM (THEORY). Breizman, B. N.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Nucl. Fusion; 14: No. 6, 873-907(Dec 1974).

The possibility of using intense relativistic electron beams (REBs) for heating plasmas in open systems is discussed. Within this context the following three sets of problems are discussed: (1) REB transport in a vacuum with a strong magnetic field; beam equilibrium, stability and critical currents in a vacuum. (2) Beam transport in a plasma; charge and current neutralization of the beam; reverse-current heating of the plasma, and macroscopic REB instabilities in the plasma. (3) The theory of collective relaxation of REBs in a plasma, including quasi-linear and non-linear relaxation models; the role of plasma nonuniformity, and macroscopic effects during REB relaxation. (auth)

22242 NEUTRON PRODUCTION AND SECOND-HARMONIC GENERATION IN LASER-TARGET EXPERIMENTS. Mascheroni, P.L. (Fusion Research Center, University of Texas at Austin, Texas 78712). Phys. Rev. Lett. 34: No. 3, 141-144 (20 Jan 1975).

Experimentalists studying the interaction of strong electromagnetic radiation with plasma have reported scattered asymmetric lines with frequency $2\omega_0$. This line and the neutron yield are correlated as a function of the peak intensity on the plasma profile. I show how the observed correlations between the $2\omega_0$ radiation and the neutron production can be explained by considering parametrics and linear effects in an inhomogeneous plasma. Scattered radiation and neutron output are discussed. (auth)

Plasma Stability

Refer also to abstracts 22346 and 22348.

22243 (COO-3077-61) STABILITY CRITERIA AND THE MAXIMUM GROWTH RATE IN MAGNETOHYDRODYNAMICS. Spies, G. O. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). Jul 1974. Contract AT(11-1)-3077. 26p. (MF-80). Dep. NTIS $4.50.

Variational methods, originally developed for deriving stability criteria from energy principles, are well suited for obtaining bounds for the maximum growth rate in arbitrary equilibria. An upper bound is derived which corresponds to a sufficient stability criterion, and a lower bound is derived which corresponds to a necessary criterion. Each of these bounds equals the actual maximum growth rate in special cases. (auth)

22244 (EUR-5182e, pp 391-398) HELICAL THETA PINCH HELIX. Cosler, A.; Dietz, K. J.; Dokopoulos, P.; Schuerer, M.; Wiegmann, W. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Plasmas with high-beta values and ion energies in the keV range are produced by the fast magnetic compression of a low density plasma. The confinement of such plasmas in a high-beta-stellarator might possibly lead to a fusion reactor. The most dangerous instability of a high-beta-stellarator, the m = 1 instability, is investigated in HELIX, a helical theta pinch. A 700 cm long coil is fed over a 1:2 step up transformer by five 60 kV capacitor banks with a total energy of 200 kJ. Each bank is crowbarred. The start switches and the crowbar switches are of the solid dielectric type. (auth)

22245 (IPP-1/149) STABILITY OF HIGH-β, HELICALLY SYMMETRIC HYDROMAGNETIC EQUILIBRIA WITH DECREASING PRESSURE PROFILE. Correa, D. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Sep 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

The influence of the geometrical parameters of helically symmetric ideal magnetohydrodynamic equilibria on the plasma β was investigated. For the calculations, it was assumed that the electric current density vanishes on the magnetic axis. Furthermore, only equilibria which satisfy stability criteria in the neighborhood of the magnetic axis were considered. The plasma β, here defined as β on the magnetic axis, was estimated assuming that the plasma radius is much smaller than the helical wavelength and that the pressure vanishes on the separatrix. Thus, β depends on the geometrical parameters of the equilibrium and on the steepness of the pressure profile, which is limited by the stability criteria. Configurations having elliptical cross sections with their major axis along the binormal to the magnetic axis and being slightly D-shaped appear to be favorable for stability and high β values. (auth)

22246 (UCID-16662) INSTABILITY DURING MONOENERGETIC NEUTRAL INJECTION INTO A TARGET PLASMA. Fowler, T. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Dec 1974. Contract W-7405-eng-48. 10p. Dep. NTIS $4.00.

During neutral injection into a target plasma in 2XIIB and other mirror machines, the injected hot ions will create a peak in the energy distribution which is well separated from the colder target ion group if the injected ions are monoenergetic. These two separate ion groups are expected to undergo a "two-component" microinstability similar to the two-stream instability. While it would be possible to avoid this circumstance by injecting additional neutral beams at different energies, it would be cheaper and simpler if these additional beams could be eliminated. Moreover, as there is limited access for neutral beams into the containment volume, the need for additional beams at lower energies would restrict the amount of current that could be injected at the more useful higher energies. In this note it is argued that multiple-energy injection is not required because the two-component (or "double-hump") instability is self-limiting and creates little losses during the process. (MOW)

22247 COMPARATIVE STUDY OF NONLINEAR EVOLUTION OF THE INSTABILITIES IN AN ELECTRON BEAM-PLASMA SYSTEM. Kawasaki, S. (Kanazawa Univ. (Japan). Faculty of Science). Phys. Lett., A; 50: No. 2, 123-124(18 Nov 1974).

The unstable wave excitation by a rotating electron beam in a plasma is studied experimentally. Related to the instability evolution, the spatial structure of the wave amplitude is found and compared with the case of the longitudinal beam. (auth)

22248 DISPERSION IN INHOMOGENEOUS PLASMA STREAMS. Pal, J.; Srivastava, K. M. (Jodhpur Univ., India). Plasma Phys.; 16: No. 12, 1192-1194(Dec 1974).

The instabilities in a two-stream plasma in which the density across the stream is variable from the point of view of a scattering problem have been studied by Burt (Burt, P. B. (1969) Plasma Phys. 3, 417). In this note this problem is extended to the case of a uniform magnetic field, applied parallel to the plasma streams. (auth)

22249 DRIFT WAVE INSTABILITY DUE TO IMPURITIES. Shut'ko, A. V.; Zherebtsov, V. A. (Inst. of Physics and Power Engineering, Obninsk, USSR). Plasma Phys.; 16: No. 12, 1191-1192(Dec 1974).

The effects of ionized impurities on the oscillations of an inhomogeneous plasma placed in a magnetic field are analyzed. These problems occur when oscillations are investigated in gas discharges, in the ionosphere, in Q-machine type devices where negative ions, for example, are present. The case of low pressure plasmas is examined as well as the case of collisional plasmas which is considered in the hydrodynamical approximation. It is shown that a specific drift wave instability due to impurities arises for moderate magnetic field conditions. (auth)

22250 THERMAL EQUILIBRIUM STATES OF NEOCLASSICAL TOKAMAK REACTOR. Kammash, T.; Galbraith, D. L. (Univ. of Michigan, Ann Arbor). Nucl. Fusion; 14: No. 6, 909-912(Dec 1974).

A number of investigations in recent years dealt with the problem of thermal equilibrium and stability of neoclassically confined tokamak fusion reactors. The approaches used in these studies varied from a highly idealized model, where all the plasma components are taken to have the same temperature and with no distinction between particle and energy confinement times, to one which distinguishes between reactants and ash and which takes into account the appropriate particle and energy diffusion constants. Although many of the results and conclusions of these investigations are similar, there appears to be some ambiguity concerning the existence of equilibrium states in neoclassically confined tokamak reactors using the DT fuel cycle. The source of the ambiguity is examined and it is shown that it has to do with the role of the α particle in the dynamics of the system. More specifically it is shown that the existence of equilibrium states depends upon the relationship between the various time constants and not upon their overall magnitude. The neoclassical diffusion theory itself is the source of the ambiguity in these relationships, since the diffusion rate for subsidiary ion species, such as the alphas, has not yet been established. (MOW)

22251 NONLINEAR EVOLUTION OF DRIFT-CYCLOTRON FLUTE OSCILLATIONS. Nekrasov, A. K. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 14: No. 6, 865-872(Dec 1974).

The nonlinear evolution of drift-cyclotron and drift-cone oscillations close to the stability limit is considered. It is shown that nonlinearity has the effect of stabilizing drift-cyclotron instability and intensifying drift-cone instability. (auth)

22252 PLASMA EQUILIBRIUM AND STABILITY IN THE SCYLLAC TOROIDAL SECTOR EXPERIMENTS. Ellis, W. R.; Jahoda, F. C.; Kristal, R.; Quinn, W. E.; Ribe, F. L.; Sawyer, G. A.; Siemon, R. E. (Los Alamos Scientific Lab., NM). Nucl. Fusion; 14: No. 6, 841-863(Dec 1974).

Experiments are reported on helical plasma equilibrium and stability in the Scyllac toroidal θ-pinch sectors (120°) which have major radii of 2.375 and 4.0 m with coil arc lengths of 5.0 and 8.4 m, respectively. In these experiments the outward toroidal drift force was compensated by a combination of l = 1 helical and l = 0 bumpy fields which are generated by shaping the inner surface of the compression coil or by driven l = 1 windings. Time-resolved measurements were made of the gross plasma-column motion, the plasma radius, the magnetic flux excluded by the plasma, the external magnetic field, the plasma density, the electron and ion temperatures, and the plasma β at axial locations of minimum and maximum plasma radius. These data are used to study the approach to the theoretically predicted toroidal equilibrium (including axial pressure equilibrium). The plasma column remained in stable equilibrium for 7 to 10 μs in the 8-m sector compared with 4 to 7 μs in the 5-m experiment, at which times the onset of a terminating m = 1, k ≈ 0 sideways motion occurred. The results show that the plasma achieved axial pressure equilibrium (nkT = const) in 4–6 μs, while maintaining equilibrium in the toroidal plane for 10 μs or longer. The measurements of the plasma radius, β and magnetic field in the various experiments have confirmed in detail the stable toroidal equilibrium observed in the streak photographs during the first 4 to 10 μs of the discharge. The observed toroidal equilibria of the high-β, θ-pinch plasma are in quantitative agreement with MHD sharp-boundary theory and confirm the theoretical scaling of the equilibrium field between the 5-m and the 8-m sector experiments. (auth)

22253 STABILITY OF DIFFUSE HIGH-BETA HELICAL SYSTEMS. Freidberg, J. P. (Los Alamos Scientific Lab., NM); Marder, B. M.; Weitzner, H. Nucl. Fusion; 14: No. 6, 809-820 (Dec 1974).

The stability of m = 1 long-wavelength kink modes in diffuse high-β l = 0 and l = 1 systems was investigated. For l = 0 it is found that new modes exist with potentially dangerous growth rates and mode structure but which degenerate into zero growth-rate modes in the sharp boundary limit. The existence of such modes provides an explanation to an apparent paradox in the literature concerning l = 0 wall stabilization. For l = 1, it is found that the sharp boundary wall stabilization of the gross m = 1 mode remains essentially unchanged for diffuse profiles. This is favorable for the Scyllac program. (auth)

22254 TEMPORAL GROWTH OF A THREE-WAVE PARAMETRIC INSTABILITY IN A FINITE PLASMA. Jha, S.S.; Srivastava, S. (Tata Institute of Fundamental Research, Bombay 400005, India). Phys. Rev. A 11: No. 1, 378-380 (Jan 1975).

The temporal growth and spatial dependence of a three-wave backscatter parametric instability are obtained for a weakly inhomogeneous but finite plasma. In contrast to the case of an infinite plasma, a slowly varying phase mismatch does not lead to the saturation of the temporal instability. (auth)

22255 QUADRUPOLE STABILIZATION OF THE PRECESSIONAL MODE OF RELATIVISTIC ELECTRON RINGS. Woodall, D.M.; Fleischmann, H.H. (School of Applied and Engineering Physics and Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14853); Berk, H.L. Phys. Rev. Lett. 34: No. 5, 260-263 (3 Feb 1975).

Experiments show that the precessional instability predicted and observed in weak electron rings trapped in a magnetic mirror field can be suppressed by adding a sufficiently strong magnetic quadrupole Ioffe field to the basic mirror field. In agreement with a theoretical analysis, the instability ceases when the Ioffe field reaches sufficient strength so that the radial gradient (dB_r/dr) of the total magnetic field strength becomes positive. (auth)

22256 COHERENT NONLINEAR THEORY OF A CYCLOTRON INSTABILITY. Sprangle, P.; Manheimer, W.M. (Naval Research Laboratory, Washington, D.C. 20375). Phys. Fluids 18: No. 2, 224-230 (Feb 1975).

A general nonlinear theory of coherent instabilities is presented and applied to the generation of microwaves by a relativistic beam. The instability is driven both by $\partial f/\partial p_\perp > 0$ and the relativistic dependence of cyclotron frequency on particle energy. This dependence can cause a bunching in the azimuthal angle in such a way as to cause net particle energy to decrease. The nonlinear evolution of this system is studied by writing the orbit equations for a small number of particles averaged over the fast time scale. The orbit equations are then integrated numerically. The equation for the mode amplitude is found by conserving energy between waves and particles. A simple analytic theory is also presented which successfully predicts the maximum field amplitude and also the behavior of the system for times long after saturation. (auth)

22257 COMMENTS ON "INFINITE-β LIMIT OF THE DRIFT INSTABILITY". Saison, R. (Max-Planck Institut für Plasmaphysik, 8046, Garching bei München, West Germany). Phys. Fluids 18: No. 2, 274-275 (Feb 1975).

Stability of the force-free high-β plasma is considered. Comments on the deviation of the dispersion relations obtained for the highly unstable made are presented. (AIP).

Thermonuclear Engineering and Equipment

22258 (BNWL-1883) INFORMATION REQUIREMENTS FOR CONTROLLED THERMONUCLEAR REACTOR ENVIRONMENTAL IMPACT STATEMENTS. Young, J. R.; Gore, B. F.; Mahlum, D. D.; Strand, J. A.; Thompson, R. C.; Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-1830. 161p. Dep. NTIS $7.60.

The current CTR development effort in the United States was reviewed to determine the most probable designs and the general types of environmental effects for the first commercial thermonuclear reactors. This review revealed that most published designs probably would have the following common characteristics if they are selected for the first commercial reactors: the D-T fusion reaction, a large 14 MeV neutron flux, lithium in the blanket region, large tritium inventories, large quantities of solid radioactive waste, and standard electricity generation systems and the associated environmental impacts. (auth)

22259 (BNWL-SA-5164(Rev.)) ENVIRONMENTAL CONSIDERATIONS FOR ALTERNATIVE FUSION REACTOR BLANKETS. Johnson, A. B. Jr.; Young, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 8 Sep 1974. 15p. (CONF-741050-3). Dep. NTIS $4.00.

From symposium on technology related for fusion reactor systems; Miamisburg, Ohio, USA (1 Oct 1974).

Comparisons of alternative fusion reactor blanket/coolant systems suggest that environmental considerations will enter strongly into selection of design and materials. Liquid blankets and coolants tend to maximize transport of radioactive corrosion products. Liquid lithium interacts strongly with tritium, minimizing permeation and escape of gaseous tritium in accidents. However, liquid lithium coolants tend to create large tritium inventories and have a large fire potential compared to flibe and solid blankets. Helium coolants minimize radiation transport, but do not have ability to bind the tritium in case of accidental releases. (auth)

22260 (CONF-740403-(Abstr.)) PROCEEDINGS OF THE ANNUAL MEETING ON THEORETICAL ASPECTS OF CONTROLLED THERMONUCLEAR RESEARCH, BERKELEY, CALIFORNIA, APRIL 3-5, 1974. (California Univ., Berkeley (USA)). 1974. Contract W-7405-eng-48. 59p. Dep. NTIS $6.00.

From meeting on theoretical aspects of controlled thermonuclear research; Berkeley, California, USA (3 Apr 1974).

Summaries are included for 59 of the conference papers. The topics covered at the conference included theoretical aspects of controlled fusion research, trapped particles, two-component systems, and pinch devices. (MOW)

22261 (EUR-5182e) PROCEEDINGS OF THE 8TH SYMPOSIUM ON FUSION TECHNOLOGY, NOORDWIJKERHOUT, NETHERLANDS, JUNE 17-21, 1974. (Commission of the European Communities, Luxembourg; Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Sep 1974. 998p. (CONF-740630-).

A separate abstract was prepared for 73 of the 77 papers presented at the meeting. The remaining 4 papers appeared previously in NSA. For abstracts of these see 30: 15184, 30: 15185, 30: 15193, and 30: 18406. (MOW)

For abstracts of individual papers see: 22171, 22172, 22189-22194, 22244, and 22262-22325.

22262 (EUR-5182e, pp 15-21) OPERATION OF THE CULHAM SUPERCONDUCTING LEVITRON. Bradford, R. E. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium in fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The Culham Levitron is a toroidal containment device in which a superconducting ring is supported entirely by the interaction of the current in the ring with radial components of the field produced by the superconducting vertical field coils. Operational experience on the machine and the behavior of some of the component systems, the vacuum system, the liquid nitrogen cooling system, cold clamps and ring cooling, and the positioners and stabilizing system, together with some of the improvements recently incorporated, are discussed. (MOW)

22263 (EUR-5182e, pp 23-38) SOME TECHNICAL ASPECTS IN THE CONSTRUCTION AND USE OF THE PADUA TOROIDAL DEVICE "ETA-BETA". Fellin, L.; Maschio, A.; Mondino, P. L.; Rostagni, G.; Stella, A. (Univ., Padua). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The system has been completed and is currently operating in a "fast" mode. To this purpose a first load assembly giving a very high toroidal induced voltage was constructed. After a short description of this load assembly, some of the technical solutions adopted and the results of a number of design and operating tests are given. In particular, some features of the flux distribution, ground currents, operation under fault conditions and the insulation performance are discussed. Systematic tests were performed on pressurized three electrode field distortion spark gaps in order to reach an operating range from the nominal voltage (± 40 kV) to zero. (auth)

22264 (EUR-5182e, pp 39-46) TECHNICAL ASPECTS OF RINGBOOG. de Haas, R. S. (FOM-Inst. voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Ringboog is a toroidal gas-blanket experiment, set up to study the partly ionized outer gas as well as the hot core. The machine is like a medium-sized Tokamak except for the vacuum enclosure. This consists of a quartz torus R = 0.51 m, a = 0.09 m interrupted by 4 T-ports for observation and pumping. A shell-type transformer is used, with central leg of 0.38 m^2 cross-section area, and a flux swing of 1.4 Vs. Transformer ratios of 1:1, 1:2, and 1:4 are possible. The primary current is driven by two delay

lines of 150 kJ in total. $B_{toroidal}$ up to 3 T is produced by 24 coils fed with 15 kA, 510 V. The construction is of the Bitter type. The 24 coils are joined by wedge-shaped pieces and held together by the magnetic forces. A vertical magnetic field from 4 loops, each carrying about 5 kA, provides balancing of the arc in the center of the tube. (auth)

22265 (EUR-5182e, pp 47-55) CONTROL OF PLASMA CURRENT IN A SHELL-LESS TOKAMAK "NOVA". Fukao, M.; Ariga, S.; Terumichi, Y.; Suemitsu, H.; Yuyama, T.; Nakamura, S.; Kubo, H.; Momota, H.; Nishihara, H. (Kyoto Univ.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

If an appropriate vertical field is applied, the growth rate of the plasma current is determined by the circuit constants of the Joule heating system. By adding a large external inductance, the plasma current wave form is defined by the external circuit constants, and then the wave form is well-reproducible. In the earliest period of plasma current build-up, the growth rate is governed by ionization collision process. By raising the vertical field gradually during this period, almost never missing ignition and well-reproducible current build-up are realized. (auth)

22266 (EUR-5182e, pp 57-64) B_ϕ COMPRESSIONAL TOKAMAK WITH FACILITIES FOR PRODUCING SHAPED CROSS-SECTION PLASMAS (TOSCA). King, R. E.; Wootton, A. J.; Robinson, D. C. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

TOSCA is an air cored, low aspect ratio Tokamak (R = 30 cms, a = 10 cms). It provides for plasma currents of up to 100 kA and toroidal confining fields of up to 13 kG rising to 26 kG during fast B_ϕ compression. Plasma cross section shapes are determined by the current distribution in the main primary winding. A B_v winding maintains toroidal equilibrium in the absence of a conducting shell. The toroidal B_ϕ field is produced by 24 single turn, cast aluminium coils supplied with energy from two separate capacitor banks. The first bank provides the initial confining field and the second is for compression. Plasma current is induced using 16 primary copper conductors supplied with energy from a multi-section capacitor bank. Bank sections and primary conductors can be linked in a variety of ways to produce various winding current distributions for plasma cross-section shaping. The vertical B_v field winding is energized from part of the same multi-section capacitor bank. (auth)

22267 (EUR-5182e, pp 65-74) TECHNICAL CONCEPT OF THE W VII STELLARATOR. Blaumoser, M.; Duesing, G.; Grieger, G.; Jaenicke, R.; Junker, J.; Kolos, J.; Meyer, P.; Streibl, B.; Wolf, G. H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A description of the machine is given, emphasizing the interaction between the main technical components with respect to the acting forces as well as to the assembling of the machine. This serves as an introduction to particular papers on W VII components in these proceedings. The magnetic loads on the toroidal field coils and those on the helical windings are treated in more detail. In both cases, the technical solutions to cope with the loads are discussed. The torque on the toroidal field coils is introduced into a central supporting cylinder via two supporting disks on top and bottom of the coils. The cylinder being twisted by this torque suffers considerable shear stresses on its vertical insulating gaps. The support structure is fabricated of cast non-magnetic steel. The magnetic load on the helical conductors results mainly in longitudinal stresses in the conductors and corresponding helical tensile stresses as well as bending moments in the vacuum vessel. Since in the case of the W VII b torus, the acting forces are ten times higher than in the largest stellarators built up to now, the strength of this component has been a major design problem, especially at the removable torus segment and at the conductor connections and water supply holes. (auth)

22268 (EUR-5182e, pp 75-79) STATUS OF WENDELSTEIN VII (W VII). Blaumoser, M.; Duesing, G.; Grieger, G.; Junker, J.; Rau, F.; Wolf, G. H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

W VII is under construction. All major components have been ordered and will be delivered in the course of the year 1974, except for the final torus and its pumping system. As planned, operation of W VII will start in 1975, using however, the torus vessel (W VII a, r_i = 17.5 cm) which had been originally foreseen. The delivery of this larger torus is expected to be delayed by about two years, partly because of the necessity to place development contracts with industry before the manufacture of this component can be started. The first experiments in W VII will be devoted to the ohmic heating studies in order to allow for an immediate application of the neutral injection program when the W VII b torus will be available. The total capital costs of the W VII (without the main power generator) are estimated. (auth)

22269 (EUR-5182e, pp 81-97) COOLING SYSTEMS OF THE W VII STELLARATOR. Elsner, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The W VII stellarator at IPP Garching includes a number of systems that will have to be cooled during operation. The systems are copper conductors, through which currents (≤ 40 kA) of short duration (≤ 10 s) are transmitted at periodic intervals (≥ 360 s) to produce magnetic and electromagnetic fields. The total heat to be removed from all systems is up to 1.5 GJ within a periodic interval. The conductors have to be cooled sufficiently by water flowing in cooling ducts so as not to exceed the permissible level of heating. In addition, the torus is to be cooled by thermal contact with another cooled system, namely the helical windings. Numerical calculations of the time-dependent thermal system parameters such as the temperatures of the copper conductors and cooling water are presented. The dimensioning calculations for designing the cooling systems of W VII, including the heat exchangers and pumps, are described. (auth)

22270 (EUR-5182e, pp 99-108) VACUUM SYSTEM OF THE W VII B STELLARATOR. Haegelsperger, H.; Heiland, W.; Poschenrieder, W.; Scherzer, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Main field coils and helical windings of a Stellarator permit only limited access to the toroidal vacuum vessel. Utilizing every possible location on the W VII b results in a large number of comparatively small portholes. Still, it should be possible to reach UHV conditions in the non-bakeable vessel. Though pulse cleaning procedures are helpful and necessary means, high pumping speed is mandatory to reach suitable conditions on an acceptable time scale. The requirements in detail are: absence of hydrocarbon handling of high gas loads of H_2 during plasma experiments, high pumping speed for contaminants during pulse cleaning, fail safe maintenance of UHV conditions between experiments, and no interference with diagnostics. These conditions are best met by a compound system, comprising turbomolecular pumps, volume getter pumps and non-magnetic ion-sublimation pumps. (auth)

22271 (EUR-5182e, pp 109-118) DESIGN AND MANUFACTURING OF THE TOROIDAL FIELD COILS OF W VII. Freudenberger, K.; Lohnert, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The toroidal magnetic field of W VII is produced by 40 normal conducting water cooled coils; 20 of these wound in left-handed direction and 20 wound in right-handed direction. They will be arranged alternately in toroidal geometry and are electrically series connected. They operate up to a current of 40 kA yielding B_0 = 4 T. Two prototype coils and a series of 46 coils have been ordered. After mechanical and electrical tests of the prototype coils the manufacturing of the series was started by the end of November last year. The peak electric power consumption per coil is 1.8 MW. The cooling parameters for pulsed operation at an average power of 50 kW are temperature rise of 25°C per pulse at a water flow of 0.5 $m^3 \times h^{-1}$. The cooling channel in the copper conductor is designed for dc operation. Each coil has its own stainless steel frame, which has two purposes (1) to transfer the magnetic forces from the coil into the W VII supporting structure and (2) to provide for the individual adjustment of each coil. The insulation material is fiberglass with epoxy resin, cured at 160°C during 14 hours. The coils are wound in horizontal position, a torque of 12 m tons at 4 rps is produced by a hydraulic motor. The conductors to be connected by brazing (SILFOS, melting point 710°C) are held by hydraulic clamps in a special brazing device. (auth)

22272 (EUR-5182e, pp 127-160) ENGINEERING DESIGN AND CONSTRUCTION OF DITE. Bayes, D. V.; Bell, D.; Burt, J.; Galloway, F.; Plummer, K. M.; Sanders, B. C.; Skelton, D. E.; Varley, G. L. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

DITE (Divertor Injection Tokamak Experiment) is an experimental assembly, at present under construction at Culham Laboratory, with the principal objectives to study the effect of powerfull neutral injection and the use of divertors in Tokamak systems. The engineering design and construction of DITE which will operate at plasma currents up to 340 kA at $q = 2$, stabilized by a position controlled feedback vertical field system are described. The major radius is 113 cm, minor radius 23 cm to give a B_ϕ ripple of 2%, or a major radius of 117 cm, minor radius 27 cm to give a B_ϕ ripple of 4%. A 28 kG B_ϕ field is produced from 16 liquid nitrogen cooled copper coils mounted on a major radius of 127 cm. The divertor is a "bundle" type which is capable of operating in B_ϕ fields of up to 18 kG. Neutral injection, initially by two and ultimately by four injectors, is intended to supply about 500 kW of beam power. The project management and organization is briefly outlined. Planning is by a Critical Path Analysis Network which predicts completion in mid-1975. (auth)

22273 (EUR-5182e, pp 161-176) VERTICAL AND RADIAL FIELD SYSTEMS OF THE DITE TOKAMAK AND THEIR CONTROLLED POWER SUPPLIES. Bayes, D. V. (Culham Lab., Abingdon, Eng.); Corbyn, D. B.; Hay, J. H. Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

DITE will be operated without a copper shell and the vertical field required for radial equilibrium of the plasma will be largely supplied as leakage from the primary windings of the core. A vertical field of ±170 Gauss will be supplied by a thyristor unit, feedback controlled by plasma position monitors. The thyristor unit has an instantaneous rating of about 2 MW and feeds two separate windings on the DITE machine, one to increase the total vertical field and one to decrease it; a complete reversal of output from −170 Gauss to +170 Gauss should be achieved in about 8 ms. This fast response will be achieved by two groups of thyristors operating at 1 kHz but interlaced so that the effective frequency of supply is 2 kHz. Field values which lie between the two extremes will be produced by controlled currents in both "positive" and "negative" windings and the control characteristic will be smooth and linear in the designed operating range. A feedback controlled radial field system will be installed to control the vertical equilibrium and will be powered by a transistor amplifier delivering about 25 kW under pulsed conditions. (auth)

22274 (EUR-5182e, pp 177-207) AIR CORE TRANSFORMER FOR THE FRASCATI TOKAMAK. Andreani, R.; Lovisetto, L.; Righetti, G. B. (CNEN, Frascati, Italy). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The 3.5 V sec flux swing needed to drive the FT plasma current is obtained using an air core transformer. The flux is stored before the experimental phase, and then forced to zero by commutation of the transformer current onto a discharge resistor. A 31 kA maximum current and 40 kV peak voltage with a decay time of 40 msec are foreseen. The transformer is made up of a central solenoid and six correcting coils. The position of the coils, and the corresponding amperturns are computed using an optimization program. An rms stray field of 20 G on the plasma periphery is obtained. The flux density in the central solenoid is very high (170 kG) and the windings must be self supporting. To solve the severe mechanical and electrical problems, hard drawn enameled copper conductors (12 conductors in parallel per turn) are used. Maximum tensile stress is 23 kg/mm^2. Cooling ducts to let the liquid nitrogen coolant flow through are left interposing glass reinforced epoxy spacers between layers of conductors. Electrical insulation is insured by mylar sheets. Models were built to test the insulation and the mechanical resistance of the central solenoid construction type with satisfactory results. A brief description of the power supply and of the commutation circuit is made. (auth)

22275 (EUR-5182e, pp 209-220) CRYOGENIC MAGNET FOR THE FRASCATI TOKAMAK. Anzidei, L.; Bettinali, L.; Celentano, G.; Malavasi, G. B.; Righetti, G. B.; Rumi, B.; Salpietro, E.; Toschi, R. (CNEN, Frascati, Italy). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A description of the design and the main features of the FT magnet, including stress and heating calculations, are presented. The choice of insulating and stress bearing material is discussed, and the construction procedure is described. Results of tests on scaled down models and status of the full scale model are reported. (auth)

22276 (EUR-5182e, pp 221-234) EFFECT OF PERTURBATIONS ON THE MAGNETIC FIELD OF THE W 7 STELLARATOR. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Due to the imperfections of the coil system perturbation fields occur, which modify the magnetic field of the W 7 Stellarator appreciably. The structure of islands caused by these perturbations was investigated numerically. The width of the islands scales with the square root of the perturbation field. If the coil system can be built with accuracy of 0.1 cm the width of the islands can be reduced to a tolerable level, but the islands cannot be avoided completely. (auth)

22277 (EUR-5182e, pp 235-245) TORUS WITH HELIX W VII A. Jaeckel, H. J.; Kisslinger, J.; Rau, F.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The design of the component torus with helix W VII A is made as simple as possible as compared to the torus with helix W VII B, in order to have it available by the end of summer 1974. Thus the minor radius was reduced, the rotational transform, the number of observations ports, and larger tolerances were used. The torus W VII A is made from forged stainless steel, major diameter 4 m. Radial and vertical observation ports are at azimuthal distances of 36 degrees. The $l = 2$, $m = 5$ helix is designed to carry a total current up to 160 kA, yielding a rotational transform of $t = 0.2$ (0.4) at a toroidal magnetic field of 4 T (3 T). Radial electromagnetic forces act on the helix up to 2.5×10^5 N/m. The stress due to the thermal expansion of the helix is reduced by the use of flexible copper elements in the helix bridges. The perturbations of the magnetic field structure caused by the helical steps are comparable to those introduced by the imperfections of the adjustment of torus with helix and toroidal field coil system, i.e., a radial offset of tilt or both components against another. (auth)

22278 (EUR-5182e, pp 247-258) DEVELOPMENT PROGRAM FOR THE 16 M DIAMETER HIGH BETA STELLARATOR HBS II. Breit, E.; Gruber, J. E.; Kaufmann, M.; Muenich, M.; Preis, H.; Schneider, W.; Schramm, G.; Seidel, U. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The toroidal experiment HBS II is intended to study wall stabilization of a high-β plasma ($\beta \approx 0.5$ to 0.9) at ion temperatures up to 1 keV in a 16 m diameter torus with an aspect ratio of 100. The confinement in the first set of experiments can be studied within a 40 to 50 μs period but an increase of the magnetic field pulse time into the millisec range is technically possible. The energy for the plasma heating by shockwaves will be delivered from an 80 kV, μsec-risetime condenser battery with pulse prolongation by a transmission line network. The design of the bank system is in progress and testing of the energy subunits has been carried out. The wall stabilization calls for a helical shaped vacuum vessel following close the coil contour. A laboratory production of quartz sectors with helical $l = I$ deformation was successfully demonstrated. (auth)

22279 (EUR-5182e, pp 259-264) DESIGN OF TORSO: AN ULTIMATE TORSATRON WITH TURBULENT HEATING. Hamberger, S. M.; Malein, A.; Sharp, L. E. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

This paper describes the design and construction of an ultimate torsatron in which closed, toroidal magnetic field surfaces of the Stellarator type, are produced solely by three helical conductors, there being no other solenoidal or poloidal field coils. An additional winding provides a fast poloidal flux change linking the plasma and results in turbulent heating. The winding allows good access for diagnostics and the whole assembly is contained within a large cylindrical vacuum tank. (auth)

22280 (EUR-5182e, pp 265-272) TECHNICAL ASPECTS OF THE GARCHING BELT PINCH-EXPERIMENTS. Breit, E.; Gruber, J.; Herppich, G.; Suess, R.; Werner, F.; Wilhelm, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The 250 kV belt-pinch is a rapid shock wave heating experiment with rectangular cross section of a low compression ratio with expected plasma temperatures from 2 to 3 keV and densities of 10^{14} cm^{-3}. The fast rising 0.5 T field in the helical wound coil is generated from a pulse-charged Blumlein system. The coil is double fed obtaining a coil voltage of 2 x 160 kV. The two-fold larger belt pinch II experiment was designed to study the plasma stability and diffusion in the time regime of up to several 100 μs. With the present layout the toroidal coil is fed from a 40 kV, 1 MJ slow rise capacitor bank, resulting in collision dominated plasma temperatures of up to 50 eV. By addition of fast pulse, 160 kV, 25 kJ Marx-generator bank, temperatures of several 100 eV should be obtained. The experiments are described. (MOW)

22281 (EUR-5182e, pp 273-316) FIRST DESCRIPTION OF THE JOINT EUROPEAN TORUS. Rebut, P. H. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The various national laboratories studying controlled nuclear fusion within the European Community, all now operate under Contracts of Association with EURATOM and carry out a co-ordinated program of research in this field. They have recently initiated, as a joint effort, the study of a major new plasma physics experiment. Subject to a successful outcome of the design study, and appropriate financial approval, it is hoped that the experiment will be built within the Community during the next few years. The experiment is known as the Joint European Torus (JET). A design study team of physicists and engineers from the various Associated Laboratories was set up towards the end of 1973 at the Culham Laboratory. (auth)

22282 (EUR-5182e, pp 317-324) ASDEX, A TOKAMAK WITH AXISYMMETRIC DIVERTOR. Allgeyer, R.; Broser, E.; Duechs, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The technical concept of ASDEX, a planned tokamak experiment with magnetic limiter and axisymmetric divertor, is described. The main components are 16 D-shaped toroidal field coils, the rectangular vacuum vessel with multipole coils and two divertor chambers, ohmic heating and vertical field coils, both situated between toroidal field coils and vacuum vessel, pumping system and structure of the experiment. (auth)

22283 (EUR-5182e, pp 327-339) COMPACT AND ECONOMIC CAPACITOR BANK FOR PUMPING THE 1000 J-LASER "ASTERIX" AT GARCHING. Klement, G.; Wedler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The experiment, which was built on the module principle and put into operation in December 1973, consists of the capacitor units for the oscillator and preamplifier and of the 690 kJ main bank for the end amplifier. Both modules are fully standardized and are complementary with respect to discharge frequency. Besides these fundamental discussions, a description is given of the various components. The triggering mechanism for the spark gaps, which operate in the range 20 to 60 kV at constant pressure and spacing, is described since it differs from conventional methods. (auth)

22284 (EUR-5182e, pp 341-354) VOLTAGE CONTROL IN THE SPICA EXPERIMENT. van Heijningen, R. J. J.; van der Laan, P. C. T.; Maris, D. J.; Meddens, B. J. H.; Oomens, A. A. M.; Sterk, A. B. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

After a short description of the screw-pinch device SPICA, the voltage limiting system of the capacitor banks is discussed. This system reduces the transient voltages from the capacitors, designed to operate at a maximum voltage of 50 kV to 20 kV, thereby avoiding cumbersome insulation arrangements. The damping system is optimized in an analogous model of the circuits. The system protecting the capacitor bank against prefiring of one of the 36 spark gaps and against operation above a voltage of 40 kV without crowbarring is described. The programming system consists of a slow pneumatic part which executes, e.g., the charging of the capacitors and the inlet of gas, and a fast part, a digital timer with optical trigger links, which executes the firing of the various banks. To minimize the number of failure shots a system is developed to interrupt this fast part. To avoid voltage peaks on the diagnostic signals, mostly magnetic coils, great care has been taken in proper grounding of the experiment and accurate screening of the cables from the diagnostics to the screened cabin. (auth)

22285 (EUR-5182e, pp 355-360) DESIGN AND TEST RESULTS OF AN INTRINSICALLY STABLE NbTi SUPERCONDUCTING ENERGY STORAGE COIL FOR HIGH VOLTAGE POWER PULSES. Salvy, C.; Maldy, J.; Santamaria, E. (Laboratoire de Marcoussis, France). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In Proceedings of the 8th symposium on fusion technology.

A superconducting device was designed to release 200 kJ pulses lasting one second, with a 50 kV peak voltage, in a variable impedance such as a discharge tube. This superconducting device consists of a fully impregnated high inductance coil (L ≃ 730 H) wound with 65 kms of an intrinsically stable NbTi wire (filaments of 30μ m diameter) and is equipped with a triggering device using a vacuum switch. The problems encountered with the choice of the materials, the insulation, the protection of the coil in the case of quenching, are discussed. The results of the measurements performed on this device are given. (auth)

22286 (EUR-5182e, pp 361-374) LARGE FLYWHEEL POWER SUPPLY FOR FUSION EXPERIMENTS IN THE MAX-PLANCK-INSTITUT FUER PLASMAPHYSIK, GARCHING, GERMANY. Knobloch, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Kottmair, M.; Schlueter, W.; Vau, G. Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A technical description is given of the main generator set. The electronic equipment and its performance are described. Transportation and installation of the 223 ton flywheel are also described. (MOW)

22287 (EUR-5182e, pp 377-390) CHEMICAL-DETONATOR SOLID-DIELECTRIC SWITCHES FOR STARTING AND CLAMP APPLICATIONS. Ford, R. D.; Young, M. P. (Naval Research Lab., Washington, DC). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Solid-dielectric switches triggered by chemical detonators have been developed at the U. S. Naval Research Laboratory for both starting switch and clamp switch applications. Ten starting switches are presently being operated in parallel on an imploding liner experiment's 530-kJ capacitor bank. Its 3 MA load current has a rise time of 13 μs. Eight parallel clamp switches operate at the 3 MA current maximum to give an L/R decay time greater than 500 μs. Each starting switch is also capable of switching a 53-kJ bank section at 60 kV with a ringing discharge of 400 kA peak current, 26 μs period and 87% reversal. In addition to describing switches developed for a specific application, various types of high speed detonators are reviewed in terms of adaptability to various switching requirements, relative cost, laboratory safety precautions, and triggering parameters. The advantages and disadvantages of the chemical-detonator driven switch as compared to more conventional switching technology is discussed. (auth)

22288 (EUR-5182e, pp 399-406) CIRCUIT BREAKER FOR POWER AMPLIFICATION IN POLOIDAL FIELD CIRCUITS. Braunsberger, U.; Salge, J.; Schwarz, U. (Technische Univ., Brunswick). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

In toroidal machines usually circuit breakers are used for power amplification in the poloidal field circuits. Currents up to several 10 kA and voltages up to 20 to 40 kV have to be controlled by the breaker. A simple method, described in this paper, is to use commercially available ac breakers together with tamped slowly exploding wires and other energy absorbing elements. Operational characteristics and test results of this current breaking method are discussed. (auth)

22289 (EUR-5182e, pp 407-419) INVESTIGATIONS ON CRYOTRON BREAKERS IN GARCHING. Amenda, W.; Pillsticker, M.; Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

For fast current commutation and switching off of circuits in superconducting coil assemblies, it is possible to use cryotron breakers, in which the switching process is caused by the phase transition from the superconducting to the normally conducting state. Triggering methods were tested on various superconductive wires in different switch designs. Thermal and current pulse triggering were investigated, the aim being to achieve the switching effect in the shortest possible time. The resistance behavior of the switch during the switching operation was clarified. The test circuits used were commutation circuits with a superconducting storage magnet and ohmic load and circuits without additional storage magnet. Currents of up to 0.825 kA were switched, commutation times of below 1 μs being achieved under certain conditions. The stray inductances of the circuit and the switch have to be considered as very important parameters because they are responsible for the high-voltage load on the switch in fast switching operations. (auth)

22290 (EUR-5182e, pp 433-439) HIGH-POWER DC NEUTRAL PARTICLE INJECTION FOR W VII. Baeumler, J.; Junker, J.; Melkus, W.; Probst, F.; Schilling, G.; Speth, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The physical requirements for a neutral particle injection system for the stellarator W VII are given together with the present status of their technical realization. Injectors with power levels of 10 to 20 kW dc were developed and are being extended. (auth)

22291 (EUR-5182e, pp 441-449) PROTOTYPE OF THE FAST NEUTRAL INJECTOR TO TFR. Becherer, R.; Bonnal, J. F.; Del-Cas, R.; Druaux, J.; Oberson, R.; Torossian, A. (CEA, Fontenay-aux-Roses, France). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

To obtain in TFR a significant increase in temperature, the injection of about 300 kW of fast neutral hydrogen beams at energies between 30 and 50 kV is planned using two lines of injection, each line composed of 5 sources. A prototype was built to test the engineering aspects of the construction and the performances of one neutral beam in experimental conditions as close as possible from those which will exist in TFR. A description of the main elements of the experimental facility and a discussion of the working parameters are given. (auth)

22292 EUR-5182e, pp 451-455) HIGH VOLTAGE AND CURRENT SUPPLY FOR NEUTRAL INJECTORS. Bariaud, A. R. (CEA, Fontenay-aux-Roses, France); Bonnal, J. F.; Del-Case, R.; Rebut, P. H.; Lisser, J. Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

To increase the plasma temperature of the TFR Tokomak at Fontenay-aux-Roses the method of injection of fast neutral beams will be applied. High voltage and current power supplies to accelerate ions produced by ion sources before neutralization have been defined for this special purpose. Each unit can deliver 60 kV, 20 A and feeds two lines of injectors. As the injection time is pulsed during 200 ms every 2 minutes, an electronic device has been studied to restore the voltage after application of the current and also to protect the electrodes and the supplies when breakdown occurs between the electrodes. (auth)

22293 (EUR-5182e, pp 457-462) PRODUCTION OF INTENSE NEUTRAL BEAMS. Green, T. S.; Thompson, E. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Neutral injection has been developed as a powerful technique for supplying energy to plasma containment experiments. In the next generation of experiments, the performance of injection system must be improved in three aspects, i.e., increased beam energy, increased beam current, and longer duration pulses. To achieve the required improvements, a number of scientific and technological problems must be solved, in the ion source, the ion extraction system and in the beam neutralizer. Consideration is given mainly to the technological problems and their probable solution. (auth)

22294 (EUR-5182e, pp 495-502) COMPUTER SYSTEM FOR MONITORING A FUSION EXPERIMENT. Murphy, E. G.; Steed, C. A.; Barry, P. D. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A monitoring system based on a PDP-8 processor is in use on the LEVITRON experiment. Its purpose is to keep a check on all the LEVITRON sub-systems (including parameters which are not measurable), keep the experimental log and provide data for determining the cause of a machine failure. (auth)

22295 (EUR-5182e, pp 503-510) MICROCOMPUTER CONTROL OF THE STELLARATOR WEGA. Schenk, G. (CEN, Grenoble, France). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The Stellerator WEGA aims to generate a plasma during 0.1 s with a repetition rate of 4 minutes using an additional 100 kW hf heating. The WEGA control system has to be set up according to the priorities, e.g., reliability, easy handling, and output text. Considering the various techniques available, the microcomputer has been choosen. Its typical application is process control where between 100 and 1000 bits in/outputs are required. The WEGA setup consists of nearly 50 subsystems, divided into four groups as: (A) power supplies, (B) machinery, (C) auxilliary sets and (D) diagnostics. Each subsystem is controllable either by local or by remote mode. The microcomputer surveys, controls, modifies and synchronizes the subsystems as well as being able of selfsurvey, execution of emergency and display. The whole central control system is mounted in a 19 inch rack. The soft-program is subdivided into subroutines, modules, subtasks and tasks, each of them being exchangeable. A plasma experiment will consist of the following tasks: survey, initialization, cyclic preparation, experimental run and edition. (auth)

22296 (EUR-5182e, pp 511-518) MODULAR SEQUENCE TIMER WITH HIGH NOISE IMMUNITY AND COMPUTER CONTROL. Fullard, K. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

This paper described a series of modules which are included in a wide-range, flexible sequence-timer for fusion experiments. The modules' main features are: (1) High noise immunity: 15 volt logic is used throughout. Control inputs are heavily filtered and all fast inputs and outputs are optically isolated. All outputs are protected against 1 kV spikes. (2) Flexibility: Small or large assemblies may be used, interconnected to form a complex "timing tree" for full system running, but permitting local control and operation of, say, an injector. Interconnections between modules are "one-wire" serial, permitting long runs between timer sub-assemblies at high signal levels. (3) High availability: The modules have comprehensive self-test facilities to speed fault finding. All modules simply plug-in, power and coaxial connections being made automatically. (4) Computer interfaces: All modules provide switch-setting data in serial form for automatic recording. Computer time-setting is available as an alternative to manual control. (auth)

22297 (EUR-5182e, pp 541-555) ADVANCES IN THE DEVELOPMENT OF THE MIRROR-HYBRID (FUSION-FISSION) REACTOR. Wolkenhauer, W. C.; Leonard, B. R. Jr.; Jenquin, U. P. (Battelle Pacific Northwest Labs., Richland, WA). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

One logical step in the development of Controlled Thermonuclear Reactors (CTRs) is the design of a hybrid fusion-fission reactor wherein the neutron-rich fusion source drives a fission assembly. Staff members of Lawrence Livermore Laboratory (LLL) and Pacific Northwest Laboratories (PNL) have joined together to develop a conceptual design of a Mirror Hybrid. The design currently has the following general characteristics. (1) The device has a sub-Lawson ($n\tau \simeq 3.0 \times 10^{13}$ cm^{-3} sec) plasma. (2) The fissile blanket is subcritical by a fraction which is large compared to the delayed neutron fraction. (3) The device has an overall output to input energy ratio substantially greater than unity. (4) The device breeds both fusion fuel (tritium) and fissile fuel (plutonium). In addition to the above general characteristics, the design is based in large part upon presently understood tech-

nology rather than extrapolation to expected future technology. The radioactive inventories of mirror hybrid reactors is reported here, along with an analysis of the reactivity insertion and loss of coolant accidents as they relate to hybrid reactors. The results of these studies have allowed for a preliminary assessment of the relative safety of hybrid reactors in comparison with fission and fusion reactors. A substantial margin exists against achieving criticality in a reactivity insertion accident and melting the fuel in a loss of coolant accident. In addition, it appears that tritium could be the controlling inventory for the hybrid reactor. Progress towards the development of a mirror hybrid reactor has resulted in identification of some of the major characteristics of hybrid reactors. It appears, on the basis of these characteristics, that the mirror hybrid can fulfill a useful role in a developing energy economy. (auth)

22298 (EUR-5182e, pp 557-562) POWER BALANCE OF JET. Piekaar, H. W. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A filling consisting of a 50/50 D–T mixture was assumed. Power input terms are Ohmic heating, α-particle energy deposition and supplementary heating. Ion thermal conduction, bremsstrahlung, and synchrotron radiation were considered as losses. It is of crucial importance whether or not the thermal losses conform to neoclassical theory. For a $Z_{eff} = 2$ and ion thermal losses ≥ 4 times neoclassical, the ignition of JET is not possible at an axial current of 3 MA. A continuous supply of 5 MW of additional heating power leads to a plasma temperature of 16 keV. If however $Z_{eff} = 2$, and the losses are less than twice the neoclassical rate, ignition is possible. It is shown that in the latter case an additional power of 5 MW is needed during 3 seconds only, to reach the break-even point. Moreover, it is shown that if ignition is achieved, the plasma will eventually reach a steady state. (auth)

22299 (EUR-5182e, pp 575-598) CONCEPTUAL DESIGN CONSIDERATIONS FOR TOKAMAK FUSION REACTORS. Conn, R. W.; Kulcinski, G. L. (Univ. of Wisconsin, Madison). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The general features of the UWMAK-I conceptual Tokamak fusion reactor are presented. UWMAK-I is a low aspect ratio (2.6), low field (B_T = 38 KGauss on axis), 5000 MW_{th} conceptual design with major radius 13m, plasma radius 5m, which is cooled with natural lithium and has 316 stainless steel as the basic structural material. An axisymmetric double null poloidal divertor is included for impurity control, and wall protection, the magnets are NbTi superconductor fully stabilized with copper and the power cycle is a Li-Na-steam system. Overall efficiency is ~30%. Specific results on neutral beam heating, microinstabilities and plasma thermal stability, neutronics, nuclear heating, materials compatibility and radiation damage, and induced activity are included. A discussion of the implications of the findings in these areas is presented. (auth)

22300 (EUR-5182e, pp 563-574) ENERGETIC AND ECONOMIC CONSTRAINTS ON THE POLOIDAL WINDINGS IN CONCEPTUAL TOKAMAK FUSION REACTORS. Arendt, F. (Kernforschungszentrum, Karlsruhe, Ger.); Herppich, G.; Knobloch, A.; Komarek, P.; Werner, F. Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The application of electrotechnical parameters which seem feasible today to the design of pulsed poloidal field windings in conceptual Tokamak reactors leads to important restrictions on the operating cycle. For three point designs of 5 GW thermal and wall loadings between 1.2 and 3.6 MW/m^2 the complete poloidal winding system was calculated to a first approximation. Using the poloidal divertor concept the principal possibilities of adjusting the poloidal coil system interlinked with the toroidal magnet to a sectionalized reactor design and the requirements of a conductor design suited for pulsed operation are considered. A table with alternative, quantitive figures for the three point designs is presented. (auth)

22301 (EUR-5182e, pp 599-607) TOKAMAK MAGNETIC FIELD CONFIGURATION. Bobbio, S.; Coccorese, E.; Di Bello, C.; Egiziano, L.; Esposito, F.; Greco, O. (Univ., Naples). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The magnetic field configuration in a minimum size Tokamak reactor was investigated. Poloidal divertors with both one or two stagnation points are considered. In either case a self-consistent equilibrium solution is found, for various typical distributions of toroidal plasma current. For all these distributions the values of external currents need be modified, but not their location. A comparison between the two kinds of divertors is made from the system feasibility point of view. (auth)

22302 (EUR-5182e, pp 609-622) CONCEPTUAL DESIGN STUDIES OF AN EXPERIMENTAL POWER TOKAMAK REACTOR. Bertolini, E.; Brunelli, B.; Engelmann, F. (CNEN, Frascati, Italy). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The thermal power output of the plant is 170 MW. The plasma and torus radia are 2.25 m and 11.25 m respectively (aspect ratio equal to 5). The average poloidal β is 2.2; the ion and electron temperatures are 25 keV and 21 keV, respectively, which corresponds to a thermally stable operation of the plasma. The confinement time is 17.6 sec, calculated on the basis of a safety factor of 0.1 with respect to the neoclassical one. The reactor is designed to operate with a single null point, poloidal field superconducting divertor. The magnetic field at the plasma axis is 4.5 tesla; the maximum field in the magnet (D-shaped, Nb-Ti conductors) is 8 tesla. The neutron wall loading is 0.99 MW/m^2. Blanket and magnet shielding are arranged in a modular form; helium cooling and stainless steel as structural materials are assumed. Boron carbide powder is the main component of the magnet shielding. The whole reactor, including the magnets, is contained in a vacuum-tight vessel. (auth)

22303 (EUR-5182e, pp 663-675) POSSIBILITIES OF LINEAR MULTIPLE MIRROR DEVICES AS THERMONUCLEAR REACTORS. Schrijver, H. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

An analysis is made of the prospects of linear multiple mirror devices for the generation of thermonuclear power. Although no direct reference is made to the source with which the plasma must be heated to thermonuclear temperatures in the first sections, the use of lasers, relativistic electron beams or turbulent heating is reviewed. The advantage of multiple mirror systems versus systems with free streaming end losses is considerable and their use may lead to an increase of one or two orders of magnitude of the confinement time of the plasma. Magnetic fields which are technically feasible impose the most severe restrictions on the parameters of the high density plasmas ($n \approx 10^{22}$ m^{-3}). With continuous reactors of reasonable length ($l_0 \approx 500$ m) the power production and the corresponding wall load are prohibitively large. The parameters of a pulsed reactor with a length of 130 m at break-even conditions are given. (auth)

22304 (EUR-5182e, pp 687-690) POSSIBILITY OF USING NORMAL CONDUCTORS FOR THE TOROIDAL MAGNET SYSTEM OF A TOKAMAK FUSION REACTOR. Ivanov, D. P.; Popkov, G. N.; Strelkov, V. S. (Inst. of Atomic Energy, Moscow). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A relation is derived for the power consumed by the coils which maintain the toroidal field and the total electric power output of a tokamak-type reactor. The calculations show that it is in principle possible to achieve $\eta = P_{loss}/P_{pow.\,out.} \leq 10\%$ but that this would require a larger size of the reactor, a high wall power loading and, rigid requirements on plasma parameters must be met which are responsible for the effeciency of the utilization of the magnetic field for plasma confinement. (MOW)

22305 (EUR-5182e, pp 691-696) SOME QUESTIONS CONCERNING GAS BLANKETS. Brandt, B.; Braams, C. M. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Some effects on the particle balance and the energy balance of a thermonuclear reactor, caused by a temperature and density profile in which the temperature decreases and the density increases towards the wall are discussed. The importance of the Nernst effect is stressed. Current research at Rijnhuizen on this subject is briefly reviewed. (auth)

22306 (EUR-5182e, pp 697-705) EFFECT OF WALL SPUTTERING ON PLASMA UNDER FUSION REACTOR CONDITIONS. Duechs, D.; Haas, G.; Pfirsch, D.; Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A simple model is used to study the impurity confinement times permissible in a reactor under steady-state conditions. It is found that under optimistic, but not unrealistic, conditions they may be ten to a hundred times the confinement time of the fuel. (auth)

22307 (EUR-5182e, pp 707-716) SIMULATION EXPERIMENT CONCERNING CERTAIN ASPECTS OF CTR PLASMA-WALL INTERACTION. Kupschus, P. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A description of an experimental facility under construction is given the purpose of which is to investigate certain aspects of the plasma-wall interaction which will presumably occur in future fusion reactors. The primary effort will be to concentrate on the problem area around divertor collector plates and divertor chamber. We will test targets (diameter of the order of 10 cm) for long-time exposure to a plasma or particle beam of hydrogen (deuterium) at fusion energies, i.e., up to 20 keV, and current densities to some 10^{17} cm^{-2} sec^{-1}. To simulate divertor conditions the experiment will be performed in a background pressure of cold gas ranging from 10^{-4} to 10^{-1} torr provided by cryopumping, and the target will be immersed in a magnetic field of up to 10 kG to more realistically influence the plasma conditions in front of the target. A plasma or particle beam of proper energy and flux density is to be generated using a multiaperture ion source as well as a Hall generator, thereafter in a second phase using an electron-cyclotron rf accelerator. The test environment will permit investigating surface effects on materials of interest at various target temperatures and geometries. Special emphasis will be placed on the correlation between erosion rates and the plasma conditions at the surface of the target. The investigation aimes at yielding results on the pump efficiency of divertor chambers with and without applying the ion burial concept and consequently on the back-diffusion of impurities towards the fusion plasma. Simultaneously we hope to reveal the mechanism of plasma-wall interaction for this particular case and to compare the obtained measurements with theoretical models being developed in parallel. (auth)

22308 (EUR-5182e, pp 747-752) TRITIUM ECONOMY OF FUSION POWER PLANTS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The tritium capacity of a fusion reactor is the most important unknown in investigations of the tritium economy. To quantify this figure, an optimization method is described which is subsequently applied to a reactor with a standard blanket and external heat exchange to an ordinary steam power cycle incorporating an intermediate liquid metal loop. The tritium recovery equipment utilizing a diffusion method is located inside a bypass to the primary coolant string. By appropriate choice of the bypass temperature level initial inventories of between 12 and 30 kg are to be expected. (auth)

22309 (EUR-5182e, pp 753-762) CONTRIBUTIONS TO THE DIFFUSION OF TRITIUM FROM LIQUID LITHIUM THROUGH NIOBIUM. Weichselgartner, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Among the suggested tritium extraction processes those which deal with diffusion through Nb membranes are most attractive. They require large membrane areas and efficient removal of T on the downstream side. An apparatus is described which was built to examine a fluidized bed assembly for T removal. In the first stage, liquid lithium is doped with hydrogen at temperatures up to 700°C. The diffusion area is formed by a niobium pot which is flushed with high-purity helium. The permeated hydrogen is measured with a highly sensitive gas chromatograph with a He ionization detector system. A hydrogen level of about 10 ppb can be attained by a special procedure. After preliminary purification in a glove-box the lithium is filtered through a sintered stainless-steel batch in the apparatus. (auth)

22310 (EUR-5182e, pp 763-775) DETERMINATION OF NEUTRON SPECTRA IN A LITHIUM SPHERE. Kappler, F.; Rusch, D.; Werle, H.; Wiese, H. W. (Kernforschungszentrum, Karlsruhe, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Neutron spectra at two radial positions of a lithium metal sphere with a 14-MeV neutron source at the center are presented. The spectra are measured both by the time-of-flight method and by proton-recoil detectors. Calculations are performed using the Karlsruhe one-dimensional S_N-transport code DTK and the neutron cross section data of the ENDF/B/III data file. The comparison of experimental and calculational results shows discrepancies both in the source neutron peak and in the lower MeV energy range. (auth)

22311 (EUR-5182e, pp 777-786) STUDIES OF THE SPACE DEPENDENT TRITIUM PRODUCTION AND THE FAST FLUX DISTRIBUTION IN A LITHIUM BLANKET EXPERIMENT. Cloth, P.; Filges, D.; Geiser, H.; Herzing, R.; Stoecklin, G. L.; Woelfle, R. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Measurements of the tritium production rates were performed in a CTR-lithium blanket model using track recorders for α-particles associated with the generation of tritons, and a radiochemical vacuum extraction technique for the tritium in irradiated Li-pellets. The fast flux distribution was determined by thorium fission fragment track recording. The experimental results are compared with calculated ones, using different computer codes. (auth)

22312 (EUR-5182e, pp 787-799) EXPERIMENTAL DETERMINATION OF THE PARTIAL PRESSURES OF D_2, LiD, AND Li_2D IN EQUILLIBRIUM WITH DILUTE SOLUTIONS OF DEUTERIUM IN LIQUID LITHIUM. Ihle, H. R.; Wu, C. H. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A knowledge of the partial pressures of the vapor species in equilibrium with dilute solutions of tritium in a blanket containing liquid lithium is important for calculating the tritium distribution in the components of a DT-fusion reactor, and for the design of a tritium recovery system. These data are particularly necessary because of the effort being made in minimizing the tritium inventory of a fusion power plant for safety and economy reasons. The composition of the vapor phase in equilibrium with solutions of deuterium in liquid lithium at very low concentrations was measured by analysis with a quadrupole mass filter of a molecular beam effusing from a Knudsen cell. It was found experimentally that at a temperature of 700°C and an atomic fraction $X_D = 10^{-6}$, the partial pressures of LiD, Li_2D and D_2 are in a ratio of about 80 : 30 : 1. The validity of Sievert's law was verified in the concentration range $10^{-6} < X_D < 10^{-4}$ at temperatures between 500 and 700°C. The measurements were also extended to atomic fractions, X_D, below 10^{-6}. Sievert's constant for the molecule D_2, and corresponding constants for the molecules LiD and Li_2D are given as functions of temperature. (auth)

22313 (EUR-5182e, pp 803-818) STRESS AND NEUTRONIC ANALYSIS OF STAINLESS STEEL STRUCTURE FOR A LITHIUM COOLED FUSION REACTOR BLANKET. Carruthers, H. M. (Associated Nuclear Services, London); Constantine, G.; Mitchell, J. T. D.; Stanbridge, J. R. Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Using the data from fast fission reactor materials studies, the design of free standing cylindrical and hexagonal cell blankets is discussed. Cylindrical cells minimize bending stresses but permit additional neutron losses through the spaces between the cells. This neutron loss is shown to be a small change in the flux at the rear of the blanket. Hexagonal cells would minimize neutron losses at the expense of lower wall loading because of bending stress limitations in the flat sides. Close packed cells of varying elliptical cross section fill the toroidal blanket space more efficiently but also have bending stress limitations. Numerical results are given, but it must be stressed that these are obtained with large extrapolations of irradiation creep and ductility data, and must therefore be used with caution. However, they demonstrate possible limitations of stainless steel structural material in a fusion reactor blanket. (auth)

22314 (EUR-5182e, pp 819-832) RADIATION DAMAGE IN STRUCTURAL MATERIALS IN A FUSION REACTOR ENVIRONMENT. Stals, L. (CEN, Mol, Belg.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

A brief review is given of radiation damage to the first wall components of a controlled thermonuclear reactor (CTR), with emphasis on blistering phenomena and bulk radiation damage effects due to 14-MeV neutrons. It is concluded that much information can be obtained from radiation damage studies in fission reactors and from simulation studies. There are however quite different radiation damage effects to be expected in a fusion reactor spectrum, which cannot merely be simulated. Therefore, reliable tests of candidate materials for CTR applications can only be performed in a so called Materials Testing CTR. (auth)

22315 (EUR-5182e, pp 833-840) MODEL FOR CALCULATING THE DAMAGE RATE. Kaletta, D.; Ehrlich, K. (Kernforschungszentrum, Karlsruhe, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

An analysis is presented of displacement damage produced in nickel. The following were calculated: (1) the elastic energy spectrum for the primary knocked-on atoms (PKA) in a Ni-target from two neutron spectra. The spectra were taken (a) from the core center of the Dounreay Fast Reactor (DFR) with total flux of 2.4×10^{15} n $cm^{-2}s^{-1}$ and (b) from the first wall of a model fusion reactor as proposed by Blow et al. with total flux of 2.8×10^{15} n $cm^{-2}s^{-1}$, (2) the number of defects produced on a cascade by a PKA of a given energy, and (3) the displacements per atom per year for both spectra: 74 for spectrum (a), 117 for spectrum (b). (auth)

22316 (EUR-5182e, pp 841-856) TEMPERATURE AND DOSE DEPENDENCE OF RADIATION DAMAGE AND BLISTER FORMATION IN NIOBIUM DUE TO 0.5 TO 9 keV HELIUM BOMBARDMENT. Roth, J.; Behrisch, R.; Scherzer, B. M. U.; Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Computer simulations for the range and damage distributions of helium ions in niobium were performed in order to understand the large depths at which blister formation has been observed experimentally. The temperature dependence of the thickness of the blister covers is explained by a simple diffusion model for the implanted helium atoms. (auth)

22317 (EUR-5182e, pp 857-867) GAS GENERATION IN THE STRUCTURE OF A FUSION REACTOR. McCracken, G. M. (Culham Lab., Abingdon, Eng.); Constantine, G. Sep 1974.

From 8th symposium on fusion technology, Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The various mechanisms by which gas can be produced in the blanket of a fusion reactor are discussed. Gas generation rates due to (n,α) and (n,p) reactions were calculated at various points in a simple reactor blanket model for a range of structural and breeding materials. The equilibrium solubility of hydrogen in some of these materials was also reviewed. The major unknown at present is the effective hydrogen solubility in radiation damaged material. Finally, some experimental data on thermal release of hydrogen and helium from metals is presented. (auth)

22318 (EUR-5182e, pp 869-879) SWELLING GRADIENTS IN THE FIRST WALL OF A STAINLESS STEEL CTR BLANKET. Perry, R. T.; Voss, J.; Koehler, W. H. (INTERATOM, Bensberg, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

An empirical relationship which relates the swelling in Type 304 stainless steel to the number of displacements per atom and the temperature is developed. The equation is used to determine the magnitude of the time dependent swelling gradients in the first wall of a fusion reactor. The results show that the swelling gradients of large magnitude develop and therefore will be a limiting factor in the life of the blanket. (auth)

22319 (EUR-5182e, pp 881-893) SURFACE DAMAGE AFTER NEUTRON INTRODUCED IMPLANTATION OF HELIUM. Andresen, H.; Gruber, J.; Lutze, W.; Migge, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Surfaces of CTR blanket structural materials will be exposed to neutron induced implantation of coolant atoms, e.g., lithium and helium. The knocked-in atoms contaminate the structural material and, in principle, may give rise to enhanced corrosion. The rate of helium implantation under CTR conditions was calculated. The corresponding depth distribution was simulated by implantation of helium (and lithium) into foils of niobium and aluminium. Helium and lithium were generated by the $^{10}B(n,\alpha)^7Li$ reaction. After implanting some 10^{16} to some 10^{17} He/cm^2 and annealing, surface effects such as blistering were observed. It is discussed that the implantation profile is an important parameter for the formation of the surface phenomena. Helium diffusion during annealing of implanted niobium was measured. In the temperature region from 350 to 1050°C no simple diffusion kinetics were found. (auth)

22320 (EUR-5182e, pp 895-905) EFFECT OF BOMBARDMENT INDUCED DAMAGE ON THE TRAPPING AND THERMAL RE-EMISSION OF DEUTERIUM FROM TUNGSTEN AND MOLYBDENUM. Erents, S. K. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The possible use of tungsten and molybdenum as materials for limiters in large plasma physics experiments has stimulated an interest in their trapping and re-emission characteristics under ion bombardment. The effects of damage on deuterium ion trapping in molybdenum was studied. These measurements were extended to tungsten, and also to bombardment at 77°K to obtain a better understanding of the trapping mechanism. As previously observed with molybdenum, tungsten exhibits marked changes in trapping and thermal re-emission after an initially annealed target is first bombarded with a damaging dose of energetic (7 to 36 keV) deuterons. All deuterium can be thermally desorbed by heating to 1000°K; however, damage is not completely annealed out until a temperature of 1700°K is reached. Results for tungsten contrast with those obtained using molybdenum in that enhancement of trapping of less than one order of magnitude (at 600°K) is observed following a high damage dose. Previous measurements on molybdenum indicated more than two orders of magnitude enhancement. Following 300°K bombardment, no enhancement in the total quantity of deuterium trapped is observed with increasing damage; however, a complete shift in the subsequent thermal desorption spectrum by 200°K is observed. This is demonstrated to result from a change in the activation energy for re-emission, a process in which desorption, rather than diffusion, appears to be the controlling step. Measurements at 77°K indicate 100% trapping until a critical dose of $\sim 2 \times 10^{17}$ ions cm^{-2} is reached, after which re-emission takes place. Post-injection thermal release spectrometry shows a number of distinct peaks at temperatures down to 140°K in molybdenum. The lower temperature peaks only appear after the critical dose is reached, and rapidly increase in magnitude with increasing dose. Since the damage must be saturated at these doses, the results are interpreted as different size clusters of gas atoms occupying sites within the material. (auth)

22321 (EUR-5182e, pp 907-913) TRAPPING AND DIFFUSION OF LITHIUM ATOMS IN NIOBIUM. Biersack, J. B.; Fink, D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Under the influence of irradiation, some Li may be implanted into structural materials of a fusion device. In view of this, a study was performed on damage, range, and diffusion profiles of implanted Li in Nb. Damage and range distributions were found to agree well with theoretical predictions. From the diffusion profiles, D (600°C) = 1.7×10^{-12} cm^2s^{-1}, and $\Delta H = 1.3$ eV is derived for Li implanted to max. concentrations of 3.5 at. % in Nb. Up to this concentration no precipitations are observed, i.e., upon heating all Li is released to the surface. In implantation experiments with low current densities at elevated temperature which simulate the conditions in fusion reactors, most Li is released to the surface. A small fraction of implanted Li is found trapped in a distribution corresponding to the radiation induced damage. This fraction of Li presumably is bound to vacancies, and remains immobile up to 1040°C. (auth)

22322 (EUR-5182e, pp 939-947) MEASUREMENT AND SYSTEMATICS OF CROSS SECTIONS FOR COMMON AND LOW YIELD 14 MeV NEUTRON INDUCED NUCLEAR REACTIONS ON STRUCTURAL FUSION REACTOR-MATERIAL AND TRANSMUTED SPECIES. Qaim, S. M.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Cross sections were measured at $E_n = 14.7 \pm 0.3$ MeV by the activation technique for (n,2n), (n,p) and (n,α) reactions on several enriched isotopes of Zr, Mo and Ru and on radioactive ^{99}Tc. Some systematic trends in the data were analyzed which allow prediction of the cross sections for long lived transmuted species (e.g., ^{93}Zr, ^{94}Nb, etc.) in the presently discussed FR-wall materials. Radiochemical measurements were carried out on six [(n,d) + (n,n'p) + (n,pn)] reactions and five (n,n'α) reactions. The cross sections lie in the mb region and depict the necessity of their consideration in radiation damage calculations. A summary of the systematic studies on the rare reactions (n,^{3}He) and (n,t) is given. (auth)

22323 (EUR-5182e, pp 949-964) COMPARISON OF DIFFERENT ANISOTROPIC SCATTERING TECHNIQUES IN NEUTRON TRANSPORT CODES. Brockmann, H. (Kernforschungsanlage, Juelich, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The neutron flux distribution in a fusion reactor blanket is strongly influenced by the anisotropic scattering of neutrons in the high energy range. To take this into account in neutronic calculations, computer codes based on the Monte Carlo method and on the method of discrete ordinates are used. The different techniques for the handling of anisotropic scattering in these transport codes are described and discussed. For a comparison of the different methods the neutron flux distribution in a simple assembly consisting of natural lithium was investigated by three computer codes, i.e., a modified version of the Monte Carlo code ESP, the discrete ordinates transport code ANISN, and the multigroup Monte Carlo code MORSE which uses the same group cross sections as ANISN. In general, the agreement between the different codes was good; even better than one would expect from the approximations made in the codes ANISN and MORSE. Some discrepancies occur at the inner and outer boundary of the assembly; but it cannot be concluded that these are due to an incorrect handling of anisotropic scattering in some of the codes. (auth)

22324 (EUR-5182e, pp 965-972) INFLUENCE OF LOW TEMPERATURE NEUTRON IRRADIATION ON THE PROPERTIES OF HARD SUPERCONDUCTORS. Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

The influence of neutron irradiation at 4.6°K on the critical current of NbTi and Nb_3Sn and the influence on the critical temperature of Nb_3Sn is treated. The decrease of the critical current of NbTi depends on the sample preparation. Annealed samples (300 to 500°C) showed a smaller decrease of the critical current than in only cold-drawn NbTi wires. Some NbTi samples were irradiated two times. After the first irradiation they were annealed at room temperature for one day and then irradiated with the same neutron dose. The result was that the critical current values after the second irradiation were smaller than after the first irradiation. Nb_3Sn showed an increase of the critical current after a dose of 4×10^{18} n/cm^2 (E > 0.1 MeV) of approximately a factor of three compared with the value before irradiation. The critical temperature showed a decrease of about 1°K. (auth)

22325 (EUR-5182e, pp 973-998) SUPERCONDUCTORS FOR TOKAMAK TOROIDAL FIELD COILS. Cornish, D. N.; Khalafallah, K. (Culham Lab., Abingdon, Eng.). Sep 1974.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

In proceedings of the 8th symposium on fusion technology.

Pulse fields are required in Tokamak machines to induce the plasma current and then to stabilize it. While the main toroidal field is essentially dc, the coils producing it will be subjected to some portion of the pulse field. It is likely that superconductors will be required to generate the toroidal field in reactors and also in machines before then in which thermonuclear reactions will take place and in which the stored magnetic energy is very large. This paper considers the problems introduced by the pulsed fields and discusses the design of suitable conductors taking pulsed losses into account in addition to the problems of stabilization and protection. Both "feasibility" and "reactor" type systems are considered and the effect of "burn" time is illustrated. (auth)

22326 (IPP-4/118) ELECTRICALLY TRIGGERED SPARK GAPS IN CAPACITOR BANKS. Klement, G.; Wedler, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). May 1974. 64p. (In German). INIS.

As one of the most important components in capacitor banks, spark gaps occupy a prominent place in high-β plasma physics. This study presents as comprehensive as possible a survey of the various spark gap concepts. The topics discussed in detail are the following: capacitive storage systems, the various types of switches in capacitor banks, the electrical discharge in air, two-electrode spark gaps of the simpler type and those with ferrite decoupling, three-electrode spark gaps (trigatron principle, the classical 3-electrode principle, ignition characteristics, 3-electrode spark gaps with simultaneous ignition), ripple and time constant of the current pulse, and the generation of primary electrons. (GE)

22327 (IPP-4/120) FIRST TEST RESULTS OF THE SIEMENS SL PROTOTYPE MAGNETS W VII IN THE MAX-PLANCK INSTITUT FUER PLASMAPHYSIK. Amenda, W.; Kullmann, D.; Krueger, P.; Pillsticker, M. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Aug 1974. 20p. (In German). Dep. NTIS (US Sales Only) $4.00.

The first test results with a big superconductive prototype coil developed for the Garching Stellarator W VII are reported. The main dimensions of the coil are: bore: 938 mm ϕ, winding cross section: 104 × 101.5 mm, and inductance: 4.44 H. Flux jumping at low currents did not start quenching. The critical current of the Nb-Ti coil reaches 91% of the short sample value. The stored energy at quenching is 1.83 MJ and the maximum value of the magnetic field in the winding region is 61.5 kG. The mechanical stresses did not damage the windings. Degradation was not observed. A training of the coil was not necessary. Altogether the test was successful, as important technical problems were satisfactorily solved. Only parts of cryogenic systems should be improved in order to reduce the helium losses. (auth)

22328 (LA-5691) SEMIEMPIRICAL CABLE DESIGN. Boicourt, G. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Coaxial cables are used extensively on Controlled Thermonuclear Research (CTR) at voltages much higher than manufacturers' ratings. The question of how such a cable should be designed is not easily answered. This report describes an approach to the problem that combines empirical knowledge and mathematical analysis. The result is an algorithm that will compute the optimal cable size for a cable having a given inductance, a given peak operating voltage, and a given maximum electric field strength in the dielectric. Suggestions for future cable research and development are given. (auth)

22329 (LA-5836-MS) NEUTRON ENERGY AND VELOCITY DISTRIBUTIONS FROM THERMAL D-T REACTIONS. Marshall, D. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

A number of general formulas which apply to the determination of the neutron energy and velocity distributions from the thermal D-T reaction are presented. Comparison of the predictions of these formulas with the results of a Monte Carlo calculation suggests that the formulas apply to temperatures in excess of 100 keV. (auth)

22330 (LA-UR-75-15) REVERSIBLE ENERGY TRANSFER BETWEEN INDUCTANCES. Wipf, S. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 8p. (CONF-741113-6). Dep. NTIS $4.00.

From international conference on energy storage, compression and switching; Turin, Italy (5 Nov 1974).

Repeatedly pulsed magnetic fields of the order of 10 GJ with rise times of 10 ms, as they would be used in a theta-pinch fusion reactor, need energy storage and transfer devices of high efficiency. Inductive storage would be favorable but needs a suitable transfer system. The transfer device must be capable of storing about half the total energy during transfer. Two possibilities are suggested, both using kinetic energy as interim storage. One is a homopolar machine, in lieu of a capacitor, and operates with liquid metal as the only movable medium. The other is switchless and works on the principle of a single phase alternator; during transfer the rotor performs half a rotation between two unstable equilibrium positions. The feasibility of the liquid metal transfer system will depend on the results of research into the losses; the other system has worked on a small scale in a fully superconducting device. (auth)

22331 (LA-UR-75-137) MAGNETIC ENERGY STORAGE SYSTEM USED IN ZT-1. Burkhardt, L. C.; Dike, R.; Di Marco, J. N.; Phillips, J. A.; Haarman, R.; Schofield, A. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 5p. (CONF-741113-4). Dep. NTIS $4.00.

From international conference on energy storage, compression and switching; Turin, Italy (5 Nov 1974).

The ZT-1 toroidal pinch experiment is driven by a magnetic energy storage system that uses four fuses to interrupt the current. One fuse package can interrupt 800 kA, develop 70 kV peak, and absorb 30 kJ. Each quadrant is driven by a fuse to increase

the total voltage around the torus to 280 kV and the total inductively stored energy is 100 kJ. Approximately 10% agreement is obtained with a numerical calculation used to predict the fuse behavior. Inductive coupling of 14 nH between the four fuses eliminates the jitter of ~0.1 μs, observed with a single fuse. (auth)

22332 (NP-20299) SOME RESULTS OF STUDY OF LASER BEAM INTERACTION WITH LiD TARGET. Dubovoi, L. V.; Dyatlov, V. D.; Kryzhanovskii, V. I.; Mak, A. A.; Medvedev, R. N.; Popytaev, A. N.; Serebryakov, V. A.; Sizov, V. N.; Starikov, A. D. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

Parameters of plasma produced by high-power Nd glass laser irradiation of LiD target were investigated. Neutron yields up to 6×10^5 neutrons/4π and electron temperatures of 1 to 2 keV were measured. The relationship between reflection coefficients and incident radiation intensity was found. This relationship cannot be explained by a classical interaction mechanism. (auth)

22333 (UCID-16649) DT FUSION NEUTRON IRRADIATION OF WRCD HEAT RESISTING ALLOYS, ORNL MAGNESIUM OXIDE CRYSTAL, BPNL MOLYBDENUM, LLL GRAPHITE, AND LLL OPTICAL GLASS. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1974. Contract W-7405-eng-48. 6p. Dep. NTIS $4.00.

Fusion neutron irradiation of various samples of Mylar, niobium, graphite, magnesium oxides, and glass is described. No results are given, only the irradiation specifics for each experiment. (MOW)

22334 (UCID-16674) SCIENTIFIC OBJECTIVES OF THE PROPOSED HIGH VOLTAGE TEST STAND. Fowler, T. K.; Pyle, R. V.; Hooper, E. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1975. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

The pacing item in the LLL/LBL Neutral Beam Development program is the capability of the test stands. The present program has two main areas of responsibility: (1) High current pulsed sources based on a redesign of our 50A, 10 millisecond source to operate at energies up to 80 keV (or more). (2) 150 to 200 keV injector with improved performance characteristics (primarily efficiency) aimed at use on TCT and other future devices, including advanced mirror systems. Some objectives of the stand are described. (MOW)

22335 (UCID-16696) DT FUSION NEUTRON IRRADIATION OF TWO BPNL PARTICLE RELEASE EXPERIMENTS. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1975. Contract W-7405-eng-48. 5p. Dep. NTIS $4.00.

During each of the two runs, a half-inch diameter, 1 mil thick niobium dosimetry foil was centered on the front of the experimental apparatus. The total beam-on time for the first run was 30.58 hours. An autoradiograph of the front of the apparatus after the irradiation showed the centering to be within about 1 mm of the center of the neutron source. The total beam-on time for the second run was 15.60 hours. Neutron production was monitored continuously during both irradiations with a proton recoil counter and recorded each hour. Dose records for both runs are attached. (MOW)

22336 BASIC ORBIT PROPERTIES OF IONS IN A MIGMA FUSION DEVICE. Gordon, M. M.; Johnson, D. A. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 121: No. 3, 461-466(1 Nov 1974).

The "Migma Cell" designed by Maglich is aimed at producing useful fusion power by storing deuterons in processing, self-colliding orbits in a suitable magnetic field. A more thorough analysis of the basic orbit properties in such a device has been undertaken. Using equilibrium orbit and transfer matrix techniques, a computer code has been developed which calculates all the important properties of median plane orbits and of vertical focusing in the given magnetic field as a function of momentum. The results obtained for the same field as used by Maglich are presented, together with a discussion of their significance for beam injection and space-charge problems. In particular, these results show that inherent alternating-gradient effects increase the vertical focusing, but beyond a critical momentum value, the vertical oscillations become unstable because of overfocusing. Finally, some of the orbit data provided by Maglich are discussed and interpreted, along with his choice of magnetic field shape. (auth)

22337 PROSPECTS FOR NUCLEAR FUSION REACTORS. Hunt, S. E. (Univ. of Aston, Birmingham, Eng.). Fuel; 54: No. 1, 3-9(Jan 1975).

A brief discussion of the basic scientific and engineering problems in controlled fusion research is given. Magnetic confinement, instabilities, heating, and energy conversion are discussed in particular. (MOW)

22338 INVESTIGATION AND TEST OF THE MAGNETIC SYSTEM OF THE JUPITER-1M ELECTROMAGNETIC TRAP. Georgievskii, A. V.; Ziser, V. E.; Lavrent'ev, O. A.; Nozdrachev, M. G.; Pogozhev, D. P. Sov. At. Energy (Engl. Transl.); 36: No. 4, 408-410(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 323-324(Apr 1974).

The Jupiter-1M experimental assembly, designed for the production and study of a plasma with thermonuclear parameters, is a cusped geometry device whose magnetic gaps are plugged by negative electrostatic potentials. The graphs of the distribution of magnetic field intensity along the axis and along the radius in the plane of symmetry of the assembly and the trace of the lines of force lying on the surface bounding the plasma volume are shown. The complete 1M assembly is briefly described. (MOW)

22339 SIMULATION OF FIRST-WALL RADIATION EFFECTS. Logan, C.M.; Anderson, J.D.; Hansen, L.F. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Vac. Sci. Technol. 12: No. 1, 536-538 (Jan 1975).

Many of the effects induced in metals as a result of exposure to a radiation environment are intimately associated with the energy of primary recoil atoms (PKAs). Protons with an energy of 16 MeV closely reproduce the PKA energy spectrum which will be present at the first wall in a D-T fusion reactor and should therefore closely reproduce the radiation effects induced by PKAs in the first wall. We have conducted a preliminary experiment with protons to measure the sputtering rate and to look for the phenomenon of chunk emission recently observed by Kaminsky and co-workers in samples exposed to 14-MeV neutrons. We are also able to observe the average projected transport range of activated PKAs. (auth)

22340 FORMATION OF FIELD-REVERSING ION RINGS USING MICROSECOND ION PULSES. Kapetanakos, C.A.; Parker, R.K. (Navel Research Laboratory, Washington, D. C., 20375); Chu, K.R. Appl. Phys. Lett. 26: No. 6, 284-286 (15 Mar 1975).

Field-reversing ion rings may be formed using microsecond ion pulses. The short-circuit of the anode-cathode gap caused by the cathode plasma is delayed by placing the diode inside a nonsymmetric cusped magnetic field. (auth)

Wave Phenomena

Refer also to abstracts 22222, 22233, 23806, and 24483.

22341 SELF-FOCUSING OF ELECTROMAGNETIC BEAMS IN A STRONGLY IONIZED MAGNETOPLASMA. Sodha, M. S. (Indian Inst. of Tech., Delhi); Khanna, R. K.; Tripathi, V. K. J. Phys., D (London); 7: No. 16, 2188-2197(1 Nov 1974).

An investigation of the self-focusing of Gaussian electromagnetic beams propagating in a strongly ionized plasma along a static magnetic field is described. The nonlinearity in the dielectric tensor of the plasma arises because of the heating and consequent redistribution of electrons along the wavefront. At low values of magnetic field the main source of electron energy dissipation is thermal conduction; for large magnetic fields the carrier mean free path becomes comparable to or greater than the Larmor radius of the electrons, and the collisional loss of energy becomes dominant. This investigation reveals that the length of self-focusing of the beam in the extra-ordinary as well as ordinary mode of propagation is reduced by the application of the magnetic field, for low values of the magnetic field ($\omega_c \ll \omega$). For higher values of the magnetic field the self-focusing of the extraordinary mode is further enhanced while that of the ordinary mode is reduced. (auth)

22342 COLLISIONLESS ION ACOUSTIC SHOCKS IN A TWO COMPONENT PLASMA. Tran, M. Q.; Bitter, M.; Hirt, P. J. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Plasma Phys.; 16: No. 12, 1198-1200(Dec 1974).

Many theoretical calculations and experiments have been carried out showing the existence of collisionless electrostatic shocks but have failed to make a clear distinction between shocks and solitons, and the shock structure for the case of cold ions has not been examined. It is the purpose of this paper to make this distinction and to deduce the shock structure starting from the field equations for the two ion species with $T_i = 0$, the electron momentum equation (neglecting the inertia term) and Poisson's equation. (UK)

22343 NONSTATIONARY SELF-FOCUSING OF A GAUSSIAN PULSE IN A PLASMA. Sodha, M.S.; Prasad, S.; Tripathi, V.K.

(Physics Department, Indian Institute of Technology, New Delhi 110029, India). J. Appl. Phys. 46: No. 2, 637-642 (Feb 1975).

In this paper the self-focusing of a cylindrically symmetric Gaussian (in space and time) electromagnetic pulse in collisionless and collisional plasmas has been studied by considering the ponderomotive force and the nonuniform heating (and consequent redistribution of electrons) as the sources of nonlinearity. The duration of the pulse is considered larger than the characteristic time of nonlinearity; the WKB and paraxial ray approximations have been used to solve the wave equation. It is found that the beam is focused in a moving filament. Because of relaxation effects the peak of the pulse is shifted to higher values of $t-z/v_g$ (in the case of collisional plasmas) and the pulse is severely distorted because of self-focusing; the shift of peak in the case of collisionless plasmas is not significant. (auth)

22344 EXCITATION OF LOWER-HYBRID WAVES BY A SLOW-WAVE STRUCTURE. Bellan, P.; Porkolab, M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Rev. Lett. 34: No. 3, 124-127 (20 Jan 1975).

We report the excitation of lower-hybrid waves by a multiple-ring slow-wave structure (four waves, $\lambda=23$ cm) in a magnetized plasma. Wavelengths measured parallel and perpendicular to the magnetic field were in agreement with the theoretical dispersion relation. The waves propagated in a packet defined by the axial length of the slow-wave structure. (auth)

22345 OBSERVATION OF NONLINEAR PHASE SHIFT OF ELECTRON PLASMA WAVES. Sugai, H.; Märk, E. (Institute for Theoretical Physics, University of Innsbruck, Innsbruck, Austria). Phys. Rev. Lett. 34: No. 3, 127-130 (20 Jan 1975).

The nonlinear phase shift which accompanies a large-amplitude electron plasma wave on a collisionless plasma column is demonstrated experimentally. The spatial evolution of the phase shift and the wave-number shift in a position-asymptotic limit are shown to be consistent with recent nonlinear theory. (auth)

22346 ION-SOUND SPECTRUM AND WAVE-ELECTRON INTERACTION IN PERPENDICULAR SHOCKS. Biskamp, D.; Chodura, R.; Dum, C.T. (Max-Planck-Institut für Plasmaphysik, D-8046 Garching, Germany). Phys. Rev. Lett. 34: No. 3, 131-134 (20 Jan 1975).

A theory is presented for the rotation of the ion-sound spectrum with respect to the drift velocity as observed in perpendicular shocks. The results of simulation confirm the main points of the theory and represent a direct verification of perturbed-orbit theory of strong turbulence. (auth)

22347 SURFACE-WAVE ABSORPTION. Kindel, J.M.; Lee, K.; Lindman, E.L. (University of California Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 34: No. 3, 134-138 (20 Jan 1975).

The 50% peak absorption predicted for resonant absorption in a linear density profile can be raised to above 90% if a different profile is used which involves a sharp jump in density along which a surface wave may propagate. Collisionless-plasma simulation studies show that at high intensities the energy goes into fast electrons which are accelerated back out of the plasma into the vacuum. (auth)

22348 TWO-DIMENSIONAL STABILITY OF AN ELECTROMAGNETIC WAVE OBLIQUELY INCIDENT ON A NONUNIFORM PLASMA. Forslund, D.W.; Kindel, J.M.; Lee, K.; Lindman, E.L. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 34: No. 4, 193-197 (27 Jan 1975).

For an electromagnetic wave obliquely incident on an inhomogeneous plasma, the dominant instability at critical density is a radiating decay instability whose associated ion-wave frequency, even in regimes where the growth rate greatly exceeds the real frequency, is approximately $(\lambda_D^2/L)^{-1/3}c_s \equiv k_{min}c_s$. The stimulated radiation peaks between the normal and backscatter angles and may be an important factor in explaining present experiments. A nonlinear calculation at modest power shows that the nonlinear state involves a large-amplitude ion wave through which the excited waves can compress the pump wave. (auth)

22349 SPACE CORRELATION IN ION-BEAM-PLASMA TURBULENCE. Grésillon, D.; Doveil, F.; Buzzi, J.M. (Laboratoire de Physique des Milieux Ionisés, Ecole Polytechnique, 91120 Palaiseau, France). Phys. Rev. Lett. 34: No. 4, 197-200 (27 Jan 1975).

We investigate the turbulence excited by an ion beam in an unmagnetized plasma in connection with the linear theory of the ion-beam-plasma instability. Depending on beam velocity, one- or three-dimensional turbulence can be expected. These two types are experimentally observed by looking at space correlation functions. (auth)

22350 TURBULENT DAMPING OF THE CONVECTIVE CELLS AND THE LOWER HYBRID WAVES. Okuda, H. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540); Chu, C.; Dawson, J.M. Phys. Fluids 18: No. 2, 243-246 (Feb 1975).

A detailed numerical study has been made of the turbulent damping of the convective cells and of lower hybrid waves for a plasma near thermal equilibrium. It is found that some of the theories of strong turbulence, taking into account the diffusing orbits of particles, are inadequate for describing the observations; observations are, however, in good agreement with the linear dispersion relation with a turbulent diffusion coefficient. (auth)

22351 OBSERVATIONS OF HARMONIC DISPERSION AND SIDEBAND COUPLING IN A PLASMA. Jahns, G.; Van Hoven, G. (Physics Department, University of California, Irvine, California 92664). Phys. Fluids 18: No. 2, 214-223 (Feb 1975).

Experiments with large-amplitude electron-wave signals demonstrate the existence of nonlinear Floquet-Bloch harmonics and of a passive four-wave coupling interaction. Propagation of the first spatial-temporal harmonic is verified by direct dispersion measurements. The parametric process acts to couple test-wave excitations at nearby frequencies symmetric about a high-level pump. Several possible models for this effect are examined, and it is shown that a four-wave mode-coupling process provides the only consistent explanation. The observed passive interaction operates at spatial positions and at pump-wave levels preceding the turn-on of the trapped-electron sideband instability, and also in the presence of detrapping interference. These results indicate the indifference of the four-wave mechanism to particle trapping, and lead to the inference that the unstable electron sidebands must also be coupled by this competing nonlinear process. Implications of this conclusion for studies of the sideband instability are discussed. (auth)

22352 STRONG FIELD HIGH-FREQUENCY PLASMA RESPONSE. Wright, T.P. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Fluids 18: No. 2, 195-200 (Feb 1975).

The plasma response to a strong high-frequency electric field has been reformulated in a way that shows that the basic nonlinear parameter is $\alpha = \Lambda\eta_0\,(\omega_p/\omega_0)^2$, where Λ is essentially the number of particles in a Debye sphere and $\eta_0 = E_0\,(4\pi n_0 k_B T)^{-1/2}$ is the usual electric field parameter. Numerical integration has produced results which show such phenomena as locally increased absorption, lower dissipation rates for strong fields, and somewhat deeper penetration of the electromagnetic wave turning point (compared with weak field results). (auth)

22353 STIMULATED COMPTON SCATTERING OF ELECTROMAGNETIC WAVES IN PLASMA. Lin, A.T.; Dawson, J.M. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Fluids 18: No. 2, 201-206 (Feb 1975).

The so-called stimulated Compton effect is investigated on a one-and-two-halves-dimensional electromagnetic plasma model. This effect results in a parametric instability in which an electromagnetic wave is backscattered off bunches of particles rather than off coherent plasma waves. Numerical simulations were carried out with pump frequency ranging from 1.8 ω_{pe} to 5 ω_{pe}. The momentum imparted by the pump wave to the plasma produces an averaged plasma drift motion in the direction of the pump wave and with velocity comparable to the electron thermal velocity ($V_0 \simeq V_T \simeq 0.1\ c$). In some cases a multiple backscatter process is believed to be the saturation mechanism of the instability. Stimulated Compton scattering has been observed even for frequencies below 2 ω_{pe} where the Raman instability cannot occur. However, in this region, a sufficiently strong pump can overcome the frequency mismatch and drive the system hydrodynamically unstable. In this situation strong acceleration of some electrons occurs producing very energetic particles. (auth)

22354 BRILLOUIN BACKSCATTERING INSTABILITY IN MAGNETIZED PLASMAS. Shukla, P.K.; Yu, M.Y.; Spatschek, K.H. (Institut für Theoretische Physik, Ruhr-Universität, D-463 Bochum, Federal Republic of Germany). Phys. Fluids 18: No. 2, 265-266 (Feb 1975).

The decay of a circularly polarized electromagnetic wave propagating parallel to an external magnetic field into another circularly polarized electromagnetic wave and an ion acoustic wave in a homogeneous plasma is considered. (auth)

22355 COLLISIONAL DAMPING OF TEMPORAL ION WAVE ECHOES. Cussenot, J.R.; Fabry, M. (Laboratoire de Physique des Milieux Ionisés, Université Nancy I, 54037 Nancy, France). Phys. Fluids 18: No. 2, 267-268 (Feb 1975).

This theoretical study of ion wave echoes is based on a model which takes into consideration ion-atom collisions. It is found that the collision model gives a damping term varying with the collision frequency ν as $\exp(-\nu t)$. (auth)

22356 INTERACTION OF AN OBLIQUELY INCIDENT ELECTROMAGNETIC WAVE WITH COLLISIONAL PLASMA HALF SPACE. Shukla, K. L. (Rajasthan Univ., Jaipur (India). Dept. of Physics). Z. Phys.; 270: No. 4, 285-288(Nov 1974).

Penetration and reflection of an electromagnetic wave incident obliquely on a semi-infinite collisional plasma is studied. The linearized Boltzmann equation is used for the perturbed plasma. By using Fourier transform technique, specular boundary condi-

tion and simple collisional model, the solution of coupled Maxwell–Boltzmann equations is presented. The field solutions consist of both longitudinal and transverse parts into the plasma region. The reflection coefficient is also obtained. (auth)

22357 NONLINEAR PLASMA OSCILLATIONS IN WATER-BAG MODELS. Wang, T. S. Urbana, IL; Univ. of Illinois (1974). 190p. University Microfilms Order No. 75-461.

Thesis (Ph. D.).

Nonlinear plasma oscillations in a single-water-bag model plasma are studied both theoretically and numerically. In the theoretical approach, the Lagrangian variables and long wavelength approximation are used. In the numerical approach, by tracing the movements of the water-bag boundaries, the time-dependent nonlinear process can be simulated on a computer. The numerical accuracy is tested by checking constants of motion and also by employing the time reversal operation. The simulation results for two types of initial water-bag boundaries are compared closely with the theoretical predictions. Excellent agreement is observed in almost all the cases under study, even for moderately large amplitude oscillations. The range of validity of the theory is determined and it is found to be much larger than what would be expected purely on the theoretical basis. Large amplitude oscillations which cause wave breaking are also simulated. After wave breaking it is observed that thin slivers of high-velocity electrons are streaming out from the main body of the plasma. A very efficient numerical code which combines both the discrete particle and the water-bag model simulation method is developed to treat the difficult problem of these thin streams of electrons. Particle trapping effect is observed by using this code. It is believed that this simulation method should be very useful to the study of other water-bag models and related problems such as two-stream instability and self-gravitating systems. (Diss. Abstr. Int., B)

ENGINEERING

Energy Conversion

Refer also to abstracts 22504, 22873–22879, 22883, 22885, and 22886.

22358 (AD-787081) RADIOISOTOPE POWER GENERATOR (RPG) 25F SHOCK ISOLATION STUDIES. Williams, R. T. (Naval Ordnance Lab., White Oak, Md. (USA)). 7 Aug 1974. 49p. (NOLTR-74-149). NTIS $3.75.

A study was undertaken to develop a graphical method for designing shock isolators for the Sentinel 25F radioisotope power generator (RPG). A mathematical model of the RPG was developed empirically from vibration-response data and used to predict the shock response of internal components. A simply supported, steel, circular plate was studied theoretically to determine its effectiveness in decreasing the input to the RPG during shock. The plate was considered structurally and dynamically representative of shock isolators that could be incorporated into systems using the RPG. A simple graphical method was developed to determine suitable shock-isolator designs. These design curves were substantiated by testing a structural model of the RPG attached to a plate isolator. (auth)

22359 (PB-235734) DEVELOPMENT AND EVALUATION OF A MODIFIED STIRLING-CYCLE ENGINE. Semiannual Report, June 1971–November 1971. Bazinet, G. D.; Fraser, R. J.; Hoffman, L. C.; Mercer, S. D.; Rudnicki, M. I. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). Dec 1971. Contract PHS-71-2488. 132p. (L-1832-01-7; PH-43-68-1435-4). NTIS $5.75.

The engine is a modified Stirling cycle engine designed to power implantable heart assist devices. Heat is provided by electric power to simulate the prototype concept of a radioisotope plus thermal storage heat source. Program activity during the report period included development of the PAC-4 actuator and testing of the MK IV (instrumented) engine. Development of sub-system components–bearings, reverser mechanisms, valves, electric heat source, thermal insulation, heat pipe cooling–was continued. The new actuator, PAC-4, was designed, fabricated and prepared for mock testing. (GRA)

22360 (PB-236230) DEVELOPMENT AND EVALUATION OF A MODIFIED STIRLING-CYCLE HEART ENGINE. Semiannual Report, December 1971–May 1972. Andrus, S. R.; Bazinet, G. D.; Faeser, R. J.; Hoffman, L. C.; Rudnicki, M. I. (Aerojet Liquid Rocket Co., Sacramento, Calif. (USA)). 7 Jun 1972. Contract PHS-71-2488. 167p. (L-1832-01-11; PH-43-68-1435-5). NTIS $6.25.

The engine is a modified Stirling cycle engine designed to power implantable heart assist devices. Heat is provided by electric power to simulate the prototype concept of a radioisotope plus thermal storage heat source. Program activity during the report period included development and testing of the PAC-4 actuator and the MK IV (instrumented) engine. Development of sub-system components–bearings, reverser mechanisms, valves, electric heat source and thermal insulation proceeded during the report period. (GRA)

22361 (TID/SNA-480) URIPS-8 SAFETY ANALYSIS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 18 Feb 1971. 91p. Dep. NTIS $7.75.

A safety analysis of the URIPS-8 under typical conditions of storage and shipping is presented. URIPS-8 is a radioisotope-fueled thermoelectric generator (RTG) designed for underseas applications at external pressures up to 500 psi. The RTG will produce at least 8 W(e), continuously, at low dc voltage, over a period of five years. It consists of a strontium-90 heat source, thermoelectric converter, thermal insulation, radiation shielding and a sealed housing. The conclusions drawn from this safety analysis are that URIPS-8 shipping packages are safe for storage and overland transport. The shipping packages meet the package configuration requirements and will withstand the normal and hypothetical accident conditions with no loss of radioactive material, and with less than the allowable reduction in radiation shielding. (TFD)

22362 (WANL-3559-2) FPMS LIFE TEST. Final Report. Van Bibber, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1975. Contract AT(11-1)-3559. 14p. Dep. NTIS $4.00.

The SNAP-23A Fueled Prototype Mockup System has been on system thermal and life test since February 1970. It has accumulated 36,200 h of testing through June 30, 1974 of which 34,600 have been accumulated on life test with the Prototype Mockup Converter (PMC-3). On June 30 the system was producing 56 W at an overall efficiency of 5.7%. The fuel power level was 978 W corresponding to 7.7 y from the nominal fuel design loading of 1180 W. During the life test period the system has performed as predicted without any significant degradation of system components and interfaces. The changes in performance have been consistent with that expected due to fuel decay. This report marks the termination of the accumulation of life test data under Contract No. AT(11-1)-3559. (auth)

22363 MHW CONVERTER DESIGN AND PERFORMANCE SUMMARY. Bixler, C. H.; Haley, V. F.; Kelly, C. E. (General Electric Co., Philadelphia). pp 15-22 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

This paper describes the Multi-Hundred Watt Radioisotope Thermoelectric Generator (MHW-RTG) design, summarizes operating characteristics for on-pad and orbital conditions, and illustrates the RTG configurations for the LES 8/9 and Mariner J and S applications. The generator uses a 2400 W ^{238}Pu heat source and has been configured to deliver 150 W of power at 30 V at the beginning of mission with a requirement to produce 125 W after 5y of orbital operation. The converter consists of 312 silicon–germanium thermoelectrics and a multi-layer molybdenum foil astroquartz insulation system housed within a sealed beryllium outer shell which serves as the RTG primary structure and external waste heat radiator. An inert cover gas is provided to protect the foil insulation during ground operations and is vented to space after launch. (auth)

22364 MULTI-HUNDRED WATT RTG: TECHNOLOGY BACKGROUND AND FLIGHT SYSTEMS PROGRAM. Arker, A. J.; Schafer, R. E. (General Electric Co., Philadelphia). pp 1-14 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The development of the MHW-RTG was initiated in 1969 by the USAEC to develop a modular isotope power system for spacecraft requiring approximately 100 to 1000 W(e). Prime objectives were high efficiency and reliability, long life, light weight, and the capability for application to a wide variety of spacecraft with minimum modifications. A summary system description and program schedule and status are presented. The major technology developments undertaken in support of the thermoelectric converters and isotope heat sources which form the RTG are also described. The MHW-RTG modules generate 150 W(e), each utilizing a 2400 W(t) ^{238}Pu heat source and SiGe thermocouples. The prime structure is a beryllium case, and the thermal insulation is alternate layers of molybdenum foil and quartz cloth. Other hardware in the system includes loading and assembly stations, shipping and storage containers, electric heat sources, test consoles, and other ancillary equipment. The first applications of the system will be for DOD satellites being built by Lincoln Laboratory, designated LES 8/9, and the NASA Jupiter/Saturn spacecraft being built by the Jet Propulsion Laboratory. The major test programs to demonstrate the electrical performance, dynamic integrity, and long life characteristics of the converter are described. It also describes the testing utilized to select material combinations and design configurations for the heat source, including tests which demonstrate its capability to withstand all credible accident environments without the release of the radioisotope. The developmental generator systems have demonstrated the capabilities of the MHW-RTG and the qualification system is in fabrication. (auth)

22365 TBC-3 FULL SCALE MHW CONVERTER ENVIRONMENTAL TESTING. Ambrose, G. R.; Wiley, R. L.; Michener, B. (General Electric Co., Philadelphia). pp 29-36 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The environmental test program conducted for the Multi-Hundred Watt Radioisotope Thermoelectric Generator (MHW-RTG) is described. The tests were performed using the second prototype generator designated Test Bed Converter Number 3, (TBC-3) containing silicon germanium thermoelectric elements. The generator was powered by a mass simulated electric heat source designed specifically for this program. The tests were performed with the converter heated to the launch or orbital operating temperature.

The test program included thermal vacuum and air performance tests, vibration and shock tests, an acoustic test and acceleration test and a magnetic field test. The results of each test are summarized and future test plans for the program are presented. (auth)

22366 PERFORMANCE MODELS FOR THE MHW CONVERTER. Kelly, C. E. (General Electric Co., Philadelphia); Loffreda, J. A.; Lorentzen, R. pp 37-46 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The MHW converter is a 150 W(e) 30 V power supply designed for a space application. The energy source is 2400 W of ^{238}Pu. Three hundred and twelve silicon–germanium thermoelectric couples convert the heat energy at an initial system efficiency of 6.5%. A molybdenum/astroquartz multifoil insulation system is used to minimize heat losses. The converter power output will decrease with time due to fuel decay and changes in the thermoelement and thermal insulation properties. A series of tests are in progress to assist in the understanding of the temperature and time dependence of the material property changes. A computer model of the MHW converter is being developed to assist in the projection of long term performance. Results of tests and modeling to date are discussed and the expected band of performance at 5 y is shown as a function of various extrapolation models and as a function of the beginning of mission hot junction temperature. (auth)

22367 THERMAL PERFORMANCE OF FOIL INSULATED SiGe CONVERTERS. Kelley, C. E. (General Electric Co., Philadelphia); Wiley, R. L.; Lorentzen, R. pp 47-54 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A summary and conclusions on the thermal performance of life tested foil insulated SiGe thermoelectric converters are presented. These test devices, which have bonafide heat balances, include C-7, C-8, the MHW 18-couple converters 18A through 18I and the full scale MHW converters TBC-1, TBC-3 and TBC-4. Each device is briefly discussed highlighting key construction features. Data are presented to show the thermal performance stability of these devices under thermal vacuum operating conditions. For purposes of comparison, thermal performance of the Min-K insulated C-1 converter is included. In addition to the thermal vacuum data, performance of the full size foil insulated converters with argon and xenon gas fills at various pressures is shown. (auth)

22368 DYNAMIC PERFORMANCE OF SiGe FOIL INSULATED DEVICES. Ambrose, G. R. (General Electric Co., Philadelphia); McLaughlin, R. D. pp 55-64 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Design features developed during the MHW RTG program to assure that the foil insulated SiGe thermopile could withstand launch environments with adequate safety margins are discussed. Potential failure modes due to qualification shock and vibration loads are considered. A series of hardware tests performed for the development and verification of the design features are presented. These evaluations encompass testing of a single unicouple at room temperature through tests of small modules to the successful demonstration of the capability of a full scale converter at full acceptance and qualification levels and at launch temperatures. (auth)

22369 LONG LIFE PERFORMANCE PREDICTIONS OF SiGe MHW-RTG. Caputo, R. S.; Truscello, V. C. (Jet Propulsion Lab., Pasadena, CA). pp 26-30 of 8th Intersociety Energy Conversion Engineering Coference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Recent experimental investigations have been incorporated into an analytical model which predicts generator performance over long time periods. The important aging mechanisms considered are degradation in foil insulation conductivity due to reactions with Si sublimed from the hot shoe and SiO_2 from the astroquartz layers; changes in hot shoe dimensions due to Si sublimation; changes in leg dimensions due to SiGe sublimation; baffling factors which are applied to the legs to correct the free sublimation model for various effects such as geometry, reactions with the astroquartz wrapping and hot shoe Si generation; new bulk property changes due to dopant precipitation and changes in radiation heat exchange due to gap streaming as leg material sublimes. Results are shown as a function of initial hot side temperature to indicate acceptable design temperatures for various mission times. Overall, this paper shows the effect on RTG performance of the comprehensive materials investigation program directed by JPL as a basis for the Mariner Jupiter/Saturn 1977 mission. (auth)

22370 SPACECRAFT STANDARDIZATION THROUGH NUCLEAR POWER. Frey, E. J. (Fairchild Space and Electronics Co.; Germantown, MD); Raab, B.; Schock, A.; Carpenter, R. T. pp 37-45 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A conceptual design study showed that standardized, shuttle-launched spacecraft serving many space missions and a wide variety of orbital conditions could be designed around the use of nuclear electric power systems. One spacecraft design was based on the use of from one to three radioisotope thermoelectric generators (RTG) to provide up to 450 W of electrical power. A second design based on a Brayton cycle alternator fueled by up to three of the same RTG heat sources meets power requirements from 500 to 2000 W. Both spacecraft provide adequate weight, volume, and mounting surfaces for most of the payloads anticipated in the 1980 decade. A key to the broad applicability of the designs is the use of waste heat from the radioisotope heat sources to provide a benign environment for all internal equipment in all orbits with minimal spacecraft changes. Economic analysis indicated that the development cost of such spacecraft would be amortized over very few missions, with significant savings thereafter. (auth)

22371 BETACEL BATTERIES FOR BIOMEDICAL APPLICATIONS. Olsen, L. C.; Seeman, S. E. (McDonnell Douglas Corp.; Richland, WA). pp 454-460 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA(13 Aug 1973).

A promising approach to long-life power sources in the submilliwatt range utilizes betavoltaic energy conversion; electric power is produced by coupling a beta source to a semiconductive device. Several hundred Betacel batteries have been fabricated over the past 3 y. Silicon n/p junction devices are combined with ^{147}Pm sources. The 2.62-y half-life of ^{147}Pm is sufficiently long to provide power for many biomedical applications for 5 to 10 y. Maximum Si ^{147}Pm conversion efficiency has been increased from ≈1 to >4%. Maximum power decreases with approximately a 2.3-y half life. The present production Model 400 battery (delivers 400 μW at BOL, is 0.96 in. high, 0.9 in. dia, weighs 98 g) powers heart pacemakers with an anticipated lifetime of 7 to 10 y. (auth)

22372 PERFORMANCE TESTING OF A TRANSIT GENERATOR AT JPL. Rouklove, P. (Jet Propulsion Lab., Pasadena, CA). pp 52-57 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A Transit type thermoelectric generator, serial number QM-III, assembled with lightweight Isotec type thermoelectric panels, has been placed on test at the Jet Propulsion Laboratory. Generator QM-III is ore of the ten generators of different types presently under test in the Isotope Thermoelectric Systems Application Laboratory of JPL, a facility specially intended for activities related to the test of fueled and unfueled thermoelectric generators. In its exterior appearance and main constructive features, generator QM-III is similar to the generator which was flown on the Transit satellite, launched into circular polar orbit on September 2, 1972. The main difference between the flight generator and QM-III is that the flight hardware is heated by radioisotope decay, while QM-III is an ETG, and is assembled with three different types of thermoelectric panels. One group of three panels, made from couples which are vacuum hot pressed, represents flight type hardware. The other two groups use panels assembled with couples representing an early technology (vacuum cold pressed). The QM-III generator is heavily instrumented, and for laboratory test purposes each group of panels is treated as an individual generator and has an independent load circuit. The paper describes the generator and test equipment used and presents the results of the tests performed to date. In addition,

tentative comparison is made between the data obtained from the flight-like panel group and the data received from the thermoelectric generator on the Transit satellite. (auth)

22373 EXTENDING THE USEFUL LIFE OF RADIOISOTOPE THERMOELECTRIC GENERATORS THROUGH ACTIVE POWER CONTROL. Raab, B.; Cherdak, A.; Rusta, D. (Fairchild Space and Electronics Co., Germantown, MD). pp 31-36 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The useful lifetime of a Radioisotope Thermoelectric Generator (RTG) may be significantly extended by use of a "mobile-shunt" power conditioning system in preference to the more common shunt-dissipative type. A mobile-shunt regulator has been designed which automatically performs this function, as well as producing a regulated stepped-up DC voltage for the load. The mobile-shunt regulator is expected to be particularly useful for generators fueled with curium-244. This potentially low-cost fuel has a half-life of 18.1 years, thus requiring some 20% excess fuel at beginning-of-life in order to achieve missions of five years. This could well result in excessively high beginning-of-life hot junction temperatures and high material degradation rates which would prevent the achievement of the required end-of-mission power. The use of a mobile shunt in place of a shunt regulator for a curium-244 silicon-germanium RTG can increase operating lifetime by 20 to 50% for a given operating temperature range, depending upon the efficiency of the mobile-shunt system. (auth)

22374 HIGH TEMPERATURE MATERIAL INTERACTIONS OF THERMOELECTRIC SYSTEMS USING SILICON GERMANIUM. Stapfer, G.; Truscello, V. C. (Jet Propulsion Lab., Pasadena, CA). pp 21-25 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The efficient use of silicon germanium thermoelectric material for Radioisotope Thermoelectric Generators (RTG) is achieved by operation at relatively high temperatures. The insulation technique which is most appropriate for this application uses multiple layers of molybdenum foil and astroquartz. Even so, the long term operation of these materials at elevated temperatures can cause material interaction to occur within the system. To investigate these material interactions, the Jet Propulsion Laboratory is currently testing a number of thermoelectric modules which use four silicon germanium thermoelectric couples in conjunction with the multifoil thermal insulation. In addition to these in-house tests, a number of basic material interaction tests are being performed by Gulf General Atomic and Resalab under contract to JPL. The paper discusses the results of the ongoing 4-couple module test program and correlates test results with those of the basic material test program. The modules are operated over a range of hot shoe temperatures from 1000 to 1200°C. The high temperatures allow various material interactions to be observed in a reasonable time span. Material interactions which could be detrimental to long term RTG applications are thus identified and corrective measures can be implemented. The performance and analysis of a module which has operated for 5000 h at a hot shoe temperature of 1150°C is described in particular detail. Material interaction such as hot shoe sublimation, material density changes and thermal insulation conductivity changes are described, evaluated and correlated with the basic material test results. (auth)

22375 BEGINNING OF MISSION FLIGHT DATA ON THE TRANSIT RTG. Bradshaw, G. B.; Postula, F. D. (Gulf Energy and Environmental Systems, San Diego, CA). pp 46-51 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The TRANSIT RTG was launched aboard a scout missile from WTR on September 2, 1972, into a nearly circular polar orbit (~425 n mi). Electrical and thermal data obtained on the RTG during ascent and for the first month in space are presented. Analysis of the flight data has been performed to verify electrical output of the RTG, determine the effects of the space environment on its operation, and evaluate stability of the device. The RTG is delivering over 35 W(e) and is reliably satisfying the TRIAD I spacecraft power requirements. Extensive instrumentation used on the TRANSIT RTG has permitted a comprehensive evaluation of the transient performance of individual thermoelectric panels in space. Experience gained during this program is useful for designing other space RTG systems, evaluating diagnostic instrumentation and sensitivity of experimental data, evaluating thermal control surfaces, and the efficiency of multifoil insulation systems in the space vacuum environment. The TRANSIT RTG is the first USAEC-developed thermoelectric converter launched to date that operates in space vacuum and the first with a five-year design lifetime. (auth)

22376 BEHAVIOR OF XENON WHEN USED AS A FILL-GAS IN A SILICON GERMANIUM RADIOISOTOPE THERMOELECTRIC GENERATOR. de Winter, F.; Stapfer, G. (Jet Propulsion Lab., Pasadena, CA). pp 9-12 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Calculations were made of the venting transient to be expected if the fill gas in a multiple RTG system is vented through a manifold after launch. The calculations agreed closely with experimental results obtained at GE on the MHW program. Xenon leakrates have been measured on the MHW Test Bed Converter No. 1 (TBC-1) at a number of pressure levels of xenon. Mass spectrometer tests have been made to determine oxygen backflow into the MHW-TBC-1 from the atmosphere when the converter is filled with xenon at a pressure higher than atmospheric. Both the xenon leakage flow and the oxygen backflow phenomena have been related to the leakage hole size spectrum. Tests were made in the TBC-1 to determine the thermal characteristics as a function of xenon pressures between 100 microns and 3 atmospheres. It was shown that there is little further decrease in power above 2 atmospheres. (auth)

22377 THERMOELECTRIC NUCLEAR BATTERIES. Olsen, L. C.; Bennett, A. (McDonnell Douglas Corp., Richland, WA). pp 461-467 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

An approach to building thermoelectric nuclear batteries in the milliwatt power range combines bismuth-telluride thermopiles with plutonia fuel capsules. Power produced by the battery is coupled to a dc–dc converter to increase the output voltage. The program involved development of bismuth-telluride thermopiles, as well as processing techniques for vacuum-packaged batteries and dc–dc converters. Thermopiles utilizing indium-bismuth solder which melts at 117°C were developed. First prototypes used Xe as the insulator between the outer can and the fuel capsule; one such battery fueled with 1.3 W(t) of ^{238}Pu produced 8 mW(e) of conditioned power, for 0.6% system efficiency. Current Model NT-50 batteries fueled with 1.5 W(t) of ^{238}Pu produce 22 mw of conditioned power, for 1.5% system efficiency; these batteries use improved bismuth-telluride thermopiles and vacuum package. The Model NT-50 battery is unaffected by 5 to 5000 Hz vibration with a maximum acceleration of 2.5 g, and shock loads of 1000 g deceleration for 1 ms. (auth)

22378 POSSIBLE MECHANISM FOR AN ELECTRODE ARC IN THE STRONG–TRANSVERSE FLOW OF A HOT GAS WITH AN EASILY IONIZED SEED. Soshnikov, V.N. (G. M. Krzhizhanovskii Energy Institute). High Temp. 12: No. 3, 413-421 (Jan 1975).

A model is proposed for the electrode arc in MHD devices which takes into account the absence of local thermal equilibrium in the arc (freezing of the chemical reactions and cascade ionization of the impurity atoms), the important contribution of resonance excitation and the subsequent deactivation of molecular vibrational states by energy redistribution among the degrees of freedom, and the decisive contribution in the main part of the arc of balance processes of Joule heating and of energy transfer by the gas flow, but not the longitudinal and transverse thermal conductivity. Sample calculations for the conditions of an experimental commercial device are performed to obtain the volt–current characteristics, and they indicate the possibility, at least in theory, of using the model to estimate the distribution of all the arc parameters. There is qualitative agreement with the existing, extremely inadequate experimental data. (auth)

22379 POSSIBLE DEVELOPMENT OF ACOUSTICAL INSTABILITY IN A SYSTEM CONSISTING OF A COMBUSTION CHAMBER AND A SUBSONIC MHD GENERATOR. Kolesnikov, V.K.; Nedospasov, A.V.; Poberezhskii, L.P. (High–Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 3, 528-532 (Jan 1975).

Within the framework of the assumptions adopted, a mathematical model of a system consisting of a combustion chamber and the channel of an MHD generator is set up, and a characteristic equation is written which permits determining the natural frequencies of the acoustical

vibrations and their increments (decrements). Numerical calculations are made. A study is made of the effect of individual parameters of the model on the stability of the acoustical vibrations. The article discusses the feedback between the combustion zone and the rest of the acoustical loop, arising as a result of the transition of pulsations of the entropy generated in the combustion zone into acoustical pulsations. The mechanism of the appearance of such pulsations is discussed. (auth)

22380 OPERATION OF THE SECTIONAL CERAMIC WALLS IN AN MHD CHANNEL. Beloglazov, A.A.; Burenkov, D.K.; Vysotskii, D.A.; Zalkind, V.I.; Kirillov, V.V.; Panovko, M.Y.; Romanov, A.I.; Smirnova, L.G.; Sokolov, Y.N.; Shumyatskii, B.Y. (High Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 3, 520-527 (Jan 1975).

The design is described for a hot sectional insulating wall of a magnetohydrodynamic generator channel; results are given from long-term tests with the U-02 apparatus, which shows that the walls work well. The electrical insulation remained high during the prolonged tests and had very little effect on the electrical characteristics of the generator. (auth)

22381 PERFORMANCE OF MOLYBDENUM ALLOYS IN A HIGH-TEMPERATURE CLOSED-CYCLE PLANT WITH AN INERT GAS. Gribov, N.N.; Dushin, Y.A.; Emel'yanova, L.I.; Solomko, Y.V. (Leningrad). High Temp. 12: No. 3, 555-558 (Jan 1975).

The authors show, using as the example a closed-cycle MHD plant, that the composition of the gas circulating in a closed circuit changes. For this reason, immediately after the start of the plant an internal oxidation of the alloy takes place followed by the formation of carbides. The SM3 alloy was selected for operation under these conditions; its analysis was: Mo-0.08 Zr-0.02 C, wt.%. In order to prevent the embrittlement of the material in a prolonged service, some changes were made in the production methods and operating conditions. The SM3 alloy is used in the closed gas circuit which incorporates an inert gas heater, the test channel, and a heat exchanger. The conducting element of the heater with a maximum temperature of 1830°C was made from OChMTs wire recommended earlier. (auth)

22382 ELECTRODE MATERIALS FOR AN MHD CHANNEL. Samsonov, G.V.; Strashinin, E.P.; Mazur, N.I.; Morozov, V.V.; Kachurin, A.K.; Kunitskii, Y.A. (Electrodynamics Institute, Academy of Sciences of the Ukrainian SSR). High Temp. 12: No. 3, 551-554 (Jan 1975).

The basic specifications for electrode materials are considered; a classification is given for electrodes in relation to the effects of the boundary layers and working temperature. The basic modes of operation are considered for cold, medium-temperature, hot, porous, liquid-jet, and arc electrodes under the conditions of an MHD channel. Recommendations are made on improving each of the electrodes, and suggestions are made on the limits to the search for materials for each. (auth)

22383 CALCULATION OF SUPERSONIC FLOW IN THE CHANNEL OF AN MHD GENERATOR. Ponomarev, V.M. (High-Temperature Institute, Academy of Sciences of the USSR). High Temp. 12: No. 3, 533-538 (Jan 1975).

This paper considers the influence of end effects and of nonhomogeneity of the electromagnetic field on the structure of the flow in the channels of an MHD generator and on its characteristics. It is assumed that the induced magnetic field and the effect of viscosity and thermal conductivity can be neglected. A comparison is made between the results of numerical calculations in the two-dimensional and hydraulic approximations. (auth)

Facilities and Equipment

Refer also to abstracts 22573 and 24702.

22384 (CONF-740964-2) SODIUM VALVE ANALYSIS CRITERIA AND METHODS. Zemanick, P. P. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 23 Sep 1974. Contract AT(45-1)-2171. 50p. Dep. NTIS $5.50.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

Criteria for structural design of sodium valves are described, i.e., national commercial standards (ASME Boiler and Pressure Vessel Code) and AEC government standards (AEC RDT standards). Emphasis was on high temperature (above 800°F for austenitic stainless steels) rules since these are in a highly developmental stage. In addition to structural criteria, analytic methods are described for structural, thermal, and hydraulic analysis, with emphasis on the difficult phenomena requiring non-linear mathematical formulation. Examples of applications to the FFTF sodium valves are presented. (auth)

22385 (ILL-RA-1973) 1973 ANNUAL PROGRESS REPORT. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)). 1973. 175p. (In French). Dep. NTIS (US Sales Only) $11.75.

The activities reported concern the use of cold and hot neutron sources of the High Flux Reactor in the 1973 program. Part one is devoted to the design, construction and operation of γ spectrometers and neutron diffractometers. Most of the changes foreseen concern the improvement of the monochromator crystals. Work on the development of new techniques relates to new types of polarizing devices with production of ultra-cold neutrons of kinetic energy as low as the simple gravitational energy of a neutron placed at a height of several meters. The section headed scientific activity covers special experiments carried out within each college on the subjects of nuclear physics, problems of pure crystals, crystallographic and magnetic structures, the study of liquids, gases and amorphous substances, imperfection, and physical biochemistry/physical chemistry. The working of the reactor during 1973, the activities of the technical services and scientific and informatics computing are reviewed briefly. (FR)

22386 (LA-5857-MS) CHEMICAL CORROSION OF MOLYBDENUM AND TUNGSTEN IN LIQUID BASALT, TUFF, AND GRANITE WITH APPLICATION TO SUBTERRENE PENETRATORS. Stark, W. A. Jr.; Krupka, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 21p. Dep. NTIS $4.00.

The chemical dissolution of molybdenum, tungsten, and some of their alloys in liquid basalt, tuff, and granite was investigated over the temperature range 1700 to 2100°K. Static compatibility tests and a limited number of fluid-motion experiments were conducted. Wet chemical, neutron-activation, and electron-microprobe analyses were used to determine compositional changes in the rock melt and on the surfaces of the metals. This study determined that tungsten was more reactive than molybdenum over a wide range of complex silicate compositions. The enhanced solubility of tungsten is discussed in terms of some simplified thermodynamically possible reactions. The detailed mechanism of dissolution, however, cannot be totally explained although correlations with, e.g., the initial rock ferric-ferrous ratio, have been obtained. A simplified geometric model has been developed for the determination of surface recession rates on Subterrene penetrators. Experimental data were used in applying the model. The limitations of experimental solubility data for performance predictions under field operating conditions of Subterrene penetrators are discussed. The results of qualitative compatibility tests made with selected high temperature-high strength metals and alloys, intermetallics, and ceramics are summarized. (auth)

22387 (NDS-10) AEROLYTE BATTERY PROGRAM. Summary Report, June 1968-December 1968. Moss, V.; Nole, D. A. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 65p. Dep. NTIS $6.25.

Research and development activities of the Aerolyte battery program are described for the period June 1 through Dec. 31, 1968. Activities included determination of the effects of cathode composition variation on cell performance, determination of cathode processing variation effects including cathode baking and moisture control, and an evaluation of separators, electrode and cathode supports, and slurried paste cells. Electrolyte solutes were also evaluated and several multi-electrode cells tested. (auth)

22388 (ORNL-SUB-3651-1) DEVELOPMENT OF A SIMPLIFIED ANALYTICAL PROCEDURE FOR DETERMINING THE INELASTIC RESPONSE OF PIPING SYSTEMS. Summary Report. Workman, G. H.; Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 25 Sep 1974. 103p. Dep. NTIS $8.25.

For Oak Ridge National Lab., TN.

Piping systems which operate at a temperature involving inelastic behavior-both initial plasticity and creep/relaxation phenomena-have been designed, built, and operated for many years. Such systems are designed in accordance with or are guided by ANSI Piping Codes. While the codes recognize the basic problem of inelasticity in piping systems, they provide only qualitative guidance. Therefore, this research effort was undertaken to develop a meaningful but relatively simple inelastic analysis tool (of adequate engineering accuracy to predict inelastic response phenomena) that does not require a large computer, excessive running time, or highly complicated input data. A formulation of a procedure to obtain the inelastic high-temperature structural response of moderately complex spatially three-dimensional piping systems is presented. This procedure is formulated within the framework of the initial strain approach of the finite-element matrix-displacement method of structural analysis. First, the general method of analysis is briefly developed. Then, the inelastic strain-generalized force relationships employed in this research effort are developed. These strain-

generalized force relationships, along with the proper deformation shape functions, are then utilized in the general method to generate the two distinct structural elements realized from this formulation: a straight and a circularly curved uniform pipe element. The introduction of these elements into a digital computer program is discussed, and finally, an example inelastic analysis is included. (auth)

22389 (ORNL-SUB-3651-3) USER'S MANUAL FOR PIRAX2, INELASTIC ANALYSIS OF 3-DIMENSIONAL PIPING SYSTEMS. Workman, G. H.; Rodabaugh, E. C. (Battelle Columbus Labs., Ohio (USA)). 10 Dec 1974. 70p. Dep. NTIS $6.50.

For Oak Ridge National Lab., TN.

A User's Manual for PIRAX2, a digital computer program designed for the inelastic analysis of spatially 3-dimensional piping systems is described. A brief theoretical development section is included to help familiarize the user with the basic approach utilized in the development of the program. This manual assumes that the user has experience in the application of elastic flexibility analysis of complex piping systems. Therefore, detailed definitions and explanations of standard terminology associated with elastic analysis of this type are not included. However, new terminology and items unique to this program are thoroughly explained with a detailed elastic and inelastic example. (auth)

22390 (PE-235085) BASIC UNDERSTANDING OF EARTH TUNNELING BY MELTING. Volume II. Earth Structure and Design Solutions. Final Report, April–September 1973. Black, D. L.; Chi, J. W. H.; Smith, R. A.; Roberts, D. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1974. Contract DOT-TSC-591. 274p. NTIS $6.50.

A novel technique, which employs the melting of rocks and soils as a means of excavating or tunneling while simultaneously generating a glass tunnel lining and/or primary support, was studied. The object of the study was to produce a good basic understanding of the fundamental process, its limits and capabilities, as applied to large scale (approximately 10 m diameter) transportation tunnels. Basic physical principles were used to derive functional equations governing the primary process variables in five separate areas, i.e., thermal power and penetrator temperature (end of Volume I), thrusting force, earth structural, glass liner structural, and melt cooldown. These were related to independent variables of penetration velocity and tunnel geometry and to the geologic model properties. Some potential design solutions are proposed to obviate some problems and limitations. A comparison with small scale test data indicates that the process is predictable but that thermal stress cracking of the glass liner would minimize its consideration for the primary tunnel support. (auth)

22391 (RN-DR-0021) NES DESIGN DEMONSTRATION TEST PROGRAM. Preliminary Edition. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1964. 35p. Dep. NTIS $4.75.

The purpose of the NES is to direct the hot nuclear exhaust gases and fission products away from the test stand during a NERVA engine firing and to provide a steam safety purge. Because of these requirements, it is necessary that a high confidence level in NES duct installation, removal, and performance be attained prior to utilizing a prototype NES duct in a full scale NERVA engine firing. To meet these requirements, the prototype NES duct will be installed, cold flow tested for performance at both NERVA design and off-design conditions, and remotely removed; thus simulating operational conditions prior to testing under actual environments. The test procedures are described. (auth)

22392 (RN-DR-0083) REPAIRS OF DISCREPANT STEAM GENERATING SYSTEM, LIQUID LINES. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 47p. Dep. NTIS $5.50.

In the process of accomplishing a water system modification to the steam generating system, a discrepant weld was discovered in the supply line undergoing modification. As a result, it was decided that random checks should be accomplished on other welds to ensure the same discrepant condition did not exist throughout the system. The checks indicated that in many cases, welding was not to specification and was inferior to the extent that remedial action was necessary. Radiographic inspection revealed the discrepant welds which were subsequently repaired and accepted in accordance with standard procedures and specifications. (auth)

22393 (RN-DR-0105(P.2)) ETS-1 MODIFICATIONS FOR 75K NERVA CONCEPTUAL STUDY. Part II. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 8 Apr 1968. 13p. Dep. NTIS $4.00.

The ROM cost estimates presented include those costs directly associated with modifications that have been identified as requirements to satisfy "Criteria for Conceptual Study—ETS-1 Modification for 75K NERVA." The costs include that direct funding required from modification identification through contractor checkout. No costs are included for other required program functions, such as facility activation, engine/TSCS/facility coordination, evaluation of other facility systems and structures, configuration management, or construction management. (auth)

22394 (RN-DR-0150(Pt.1)) ETS-1 MODIFICATIONS FOR 75K NERVA CONCEPTUAL STUDY. Part I. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 8 Apr 1968. 81p. Dep. NTIS $7.25.

This study defines a concept for modifying Engine Test Stand No. 1 to accommodate testing of the NERVA engine system. (TFD)

22395 (RN-DR-0150(Suppl.1)(Pt.2)) SUPPLEMENT 1. ETS-1 Modification for 75K NERVA. NERVA Altitude-Simulation System, Trade-Study Report. Part II. Cost Backup. DaVolio, J. R.; Unger, R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1969. 41p. Dep. NTIS $5.25.

22396 (RN-DR-0197) RESULTS OF THE AUTOMATIC ORBITAL WELDING EQUIPMENT DEMONSTRATION. Fletcher, C. W.; Livers, G. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 36p. Dep. NTIS $5.00.

Two automatic orbital welding systems (Dyna Surge by Liquid Carbonic and Astro-Arc by Astro-Arc Company) were evaluated for NERVA line welding. The materials welded were 5086 aluminum and Inconel 718. The tests indicated that the Astro-Arc is functionally the better welding system for in-place welding of NERVA lines. (TFD)

22397 (RN-FOP-0002) NERVA PROGRAM. Operating Procedure, GH_2 Fill Station, Test Cell A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Aug 1963. 31p. Dep. NTIS $4.75.

The instructions described in this procedure are typical of Test Cell A (TCA) operations relative to the KIWI-B4A reactor. Operation of TCA during NRX reactor tests requires modifications dictated by specific test requirements. Under NRX conditions, it is the responsibility of the test cell manager (TCM) to evaluate the capabilities of TCA in terms of given test requirements and set forth detailed check-lists which will be compatible with the test requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the hydrogen fill station. Local operation includes all procedures required to assure functional integrity of the system, compatibility with test requirements prior to transferring operation to remote control, and securing the system after remote operation. The contents of this procedure are intended for use by the test cell manager, systems engineers and technicians responsible for the operation of the hydrogen fill station. The general plan at the fill station and schematic diagram of piping described in this procedure is shown. (auth)

22398 (RN-FOP-0004) NERVA PROGRAM. Operating Procedure, GN_2 Fill Station, Test Cell A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Sep 1963. 16p. Dep. NTIS $4.00.

The instructions described in this procedure are typical of the operation of Test Cell A (TCA) relative to the KIWI program. Operation of TCA during the NRX reactor tests requires modifications dictated by specific requirements. Under NRX conditions, it is the responsibility of the test cell manager (TCM) to evaluate the capabilities of TCA in terms of given test requirements and then make detailed check lists fulfilling those requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the GN_2 fill station. Local operation includes all procedures required to assure functional integrity of the system. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the operation of the GN_2 fill station. (auth)

22399 (RN-FOP-0006) NERVA PROGRAM. Test Cell A Vacuum System. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1 Jun 1963. 20p. Dep. NTIS $4.00.

The instructions in this procedure are typical of Test Cell A operation relative to the the KIWI-B4A. Operation of Test Cell A relative to the NRX reactor requires modifications dictated by specific test requirements. Under NRX conditions, it is the responsibility of the test cell manager to evaluate the capabilities of Test Cell A in terms of given test requirements and then set forth detailed checklists which will be compatible with the test requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the vacuum system. Local operation includes procedures required to assure functional integrity and compatibility of the system with the test requirements prior to transferring system

operation to remote control, and to secure the system after remote operation. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the functional integrity of the vacuum system. (auth)

22400 (RN-FOP-0008) NERVA PROGRAM. Test Cell A Flare System Operation. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 May 1963. 32p. Dep. NTIS $4.75.

The instructions given in this procedure are typical of Test Cell A operation relative to the KIWI-B4A. Operation of Test Cell A (TCA) relative to the NRX reactor requires modifications dictated by specific test requirements. Under NRX conditions, it is the responsibility of the test cell manager to evaluate TCA capabilities in terms of given test requirements and set forth detailed check lists which are compatible with a particular application. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the flare systems. Local operation includes necessary procedures to assure functional integrity of the system and compatibility with the test requirements prior to transferring system operation to remote control, and to secure the system after remote operation. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the functional integrity of the flare systems. (auth)

22401 (RN-FOP-0009) NERVA PROGRAM. Test Cell A Room Inerting System Operation. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 May 1963. 14p. Dep. NTIS $4.00.

The instructions in this procedure are typical Test Cell A (TCA) operations relative to the KIWI-B4A reactor. Operation of TCA relative to the NRX reactor requires modifications dictated by specific test requirements. Under NRX conditions it is the responsibility of the test cell manager to evaluate TCA capabilities in terms of given test requirements and then set forth detailed checklists that are compatible to a particular application. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the room inerting system. Local operation includes procedures required to insure functional integrity of the system and compatibility with the test requirements prior to transferring system operation to remote control, and securing the system after remote operation. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for functional integrity of the room inerting system. (auth)

22402 (RN-FOP-0013) NERVA PROGRAM. Test Cell A, LH_2 Turbopump Operation. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Jul 1963. 10p. Dep. NTIS $4.00.

The instructions described in this procedure are typical of Test Cell A operation relative to the KIWI-B4A. Operation of Test Cell A relative to the NRX reactor requires modifications dictated by specific test requirements. Under NRX conditions, it is the responsibility of the test cell manager to evaluate the capabilities of Test Cell A in terms of given test requirements and then set forth detailed checklists which will be compatible with the test requirements. The purpose of this procedure is to acquaint operating personnel with typical techniques for local operation of the LH_2 turbopump system. Local operation includes procedures required to assure functional integrity and compatibility of the system with test requirements prior to transferring system operation to remote control, and to secure the system after remote operation. The contents of this procedure are intended for use by the test cell manager, systems engineers, and technicians responsible for the functional integrity of the LH_2 turbopump system. (auth)

22403 (RN-NC-0012) INVESTIGATION OF RNO ANALOG COMPUTER FIRE OCCURRING ON 16 AUGUST 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Nov 1967. 49p. Dep. NTIS $5.50.

On Aug. 16, 1967, at 0135 hours, a fire occurred in the console of the NRO analog computer. The fire was extinguished by the sprinkler system before the fire department arrived. This report presents the findings of a committee set up for the purpose of assessing the equipment damage, determining the probable cause of the fire, and instituting such controls and corrective actions as deemed necessary. (TFD)

22404 (RN-NC-0013) USE OF THE HES 1-MEGAWATT ARC-HEATER TO HEAT HYDROGEN. Adams, J. M.; Cruddace, R. G.; Jassowski, D. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 24p. Dep. NTIS $4.25.

Some problems related to the development of nuclear rocket engines may be studied experimentally if sufficient hot hydrogen can be produced. Tests have shown that a particular arc-heater, the Hyperthermal Environmental Simulator, can produce hydrogen at temperatures between 2800 and 3600°K. The arc consumes between 800 and 1200 kW of electrical power and maintains an energy conversion efficiency of about 40%. At maximum power the arc can produce varying amounts of hydrogen, depending on the temperature (e.g., 8 gm/s at 3300°K and 13 gm/s at 2500°K). There are fluctuations in power during arc operation, lasting about 0.1 second and causing the hydrogen temperature to fluctuate by as much as 50°K. The maximum arc power (1200 kW) is reached when the arc current becomes sufficient to cause rapid erosion of the tungsten cathode of the arc chamber. In these tests the temperature of the gas was obtained indirectly from energy balances performed for the arc chamber and the exhaust duct, and directly by an optical method in which the radiance of the gas was compared to that of a tungsten filament at a single wavelength, 5890 Å, the center of a sodium D-line. (auth)

22405 (RN-S-0342) INSTALLATION CRITERIA, ETS-1 TEST STAND ADAPTER. Campbell, J. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1966. 15p. Dep. NTIS $4.00.

These criteria describe the requirement for the installation and check-out of the Test Stand Adapter (TSA) on the facility thrust ring in ETS-1 and along with the referenced documents form the basis from which the detailed procedure may be developed to accomplish these tasks. (auth)

22406 (RN-S-0383(Ph.2)) QUALIFICATION TEST FIRINGS OF PHASE II CONTAINMENT CAPSULES AT AEROJET-GENERAL DOWNEY PLANT. Final Test Report. Voreck, W. E.; Downs, M. E.; Lindberg, E. I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1967. 70p. Dep. NTIS $6.50.

The results of the four Countermeasures Radiation Effects Program Phase II capsule qualification tests conducted at the Aerojet-General Corporation, Downey Facility are presented. These tests were conducted by detonating 160 g of high explosive in the Phase II capsules and measuring the shock pressures transmitted into the surrounding water media. A maximum of 80 g of explosive will be irradiated in the Phase II capsule. In addition to test measurements, analytical calculations of the shock wave are compared. (auth)

22407 (RN-TD-0048) TEST DESCRIPTION FOR THE VIBRATION SURVEY OF THE TPA-UPPER TURBINE INLET LINE ASSEMBLY AS INSTALLED IN XECF. Rosser, R. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1968. 9p. Dep. NTIS $4.00.

The manner in which a detailed vibration survey will be performed on the XECF TPA-Upper Turbine Inlet Line Assembly is described. The test will be performed at E-MAD on the XECF Engine as it is supported in a holding stand. All instrumentation and test equipment necessary to conduct this test will be independent of the present XECF measurement instrumentation. (auth)

22408 (RN-TM-0129) PRELIMINARY STUDY OF TEST STAND CONTROL REQUIREMENTS FOR NERVA NOZZLE DEVELOPMENT TESTS. Ferrer, F. F.; Carroll, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Sep 1964. 18p. Dep. NTIS $4.00.

This study was initiated to assist the REON design, project and test groups in identifying the transient and steady-state control requirements for NERVA Nozzle development tests. These tests are being conducted in the H (or C) areas, LRO, Sacramento. (auth)

22409 (RN-TM-0370) ETS-1 STEAM GENERATOR INJECTOR FACE WELD CORROSION. Lamvermeyer, D. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1966. 11p. Dep. NTIS $4.00.

The three ETS-1 steam generator injectors S/N's 016, 017, and 018 experienced extensive preferential corrosion and pitting attack in the LOX nozzle to injector face weld joint areas during test series operations. Results of a study to determine the causes of the corrosion and remedial actions are presented. (TFD)

22410 (RN-TM-0554) REPRESSURIZATION CHARACTERISTICS OF A ROCKET ENGINE TEST COMPARTMENT OPERATING AT SUBATMOSPHERIC PRESSURE. Fairall, R. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1967. 28p. Dep. NTIS $4.50.

Development testing of the NERVA nuclear-powered technology engine requires a test stand incorporating a compartment to enclose the engine and a duct to conduct the heated propellant away from the stand. During system operation the compartment and part of the duct are at subatmospheric pressure. Theory predicts and tests confirm that relatively rapid changes in the flow in the duct result in pressure oscillations whose magnitude depends on the nature and rapidity of the change. In many cases

which could be expected to occur as a result of a specific component or subsystem malfunction (and in a few which have occurred), the overpressures resulting from the inertia of gas backflow can produce significant stress on the ETC. In addition, certain modes of system shutdown can result in similar repressurization characteristics. Fortunately, linear network theory appears to satisfactorily predict the magnitude of overpressures and the system response time for both planned operations and unplanned component malfunction. This knowledge enables steps to be taken in system modification and/or operating procedures to minimize deleterious repressurization effects. (auth)

22411 (RP-TM-0009) EXPERIMENTAL DETERMINATION OF PRELOAD OF BOLTS USING S-122 FLUOROCARBON RELEASE AGENT. Smoot, M. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Apr 1966. 10p. Dep. NTIS $4.00.

One of the most frequent errors in the design of bolted joints occurs in the calculation of preload created by the bolts. Usually the error is caused by assuming the wrong friction coefficient for the thread lubricant. Results of torque/load tests of several bolts used on the Phoebus 2 test assembly, PN1115858, with S-122 Fluorocarbon Release Agent as the thread lubricant are presented. (TFD)

22412 (TID/SNA-78) KIWI-B FLOW CONTROL COMPONENT DEVELOPMENT PROGRAM. Preliminary Application for Facilities. (Aerojet-General Corp., Azusa, Calif. (USA)). 22 May 1958. Contract AF33(616)-5552. 10p. Dep. NTIS $4.00.

The application from Aerojet-General Corporation to Wright Air Development Center for facilities necessary to conduct research and development testing in connection with the complete propellant flow control systems for the KIWI B experiments is presented. The facility would be located at the Aerojet-General Sacramento Plant in order that existing support services could be utilized. (TFD)

22413 (TID/SNA-118) DESIGN AND TEST REQUIREMENTS FOR NASS EXHAUST DUCT SYSTEM (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 45p. Dep. NTIS $5.25.

This document defines the design requirements for the Exhaust Duct System (EDS) of the NERVA Altitude Simulation System (NASS) as installed in Engine Test Stand-1 (ETS-1) at the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada. The relationship of this document to the ETS-1 Modification Program for the NERVA engine is described in F007-CP090219-EA, "ETS-1 Design Criteria." (auth)

22414 (TID/SNA-211) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT COOLANT LINES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

The specification establishes the performance, design, test and qualification requirements for equipment identified as structural support coolant lines (SSCL) for the NERVA Reactor. The SSCL transports propellant from the pump discharge line and from the cooldown supply line to the pressure vessel closure inlet. (auth)

22415 (TID/SNA-274) ENGINE TEST STAND NO. 1 (ETS-1), FACILITY REQUIREMENTS DOCUMENT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. Contract SNP-1. 94p. Dep. NTIS $7.75.

This document has been prepared to present the basic facility requirements necessary to support the NERVA program for the development and qualification engine test program at Engine Test Stand Number One (ETS-1). A reference engine has been established with sufficient definition to prepare facility requirements for design, procurement, scheduling, and budgetary purposes since facility considerations primarily involve the test article envelope and interfaces. (auth)

22416 (TID/SNA-275) NERVA TURBOPUMP BEARING SPECIAL TEST EQUIPMENT REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 26p. Dep. NTIS $4.50.

The special test equipment and basic facilities necessary to support the evaluation testing of LH_2 cooled 65 mm roller bearings for the NERVA turbopump are described. (TFD)

22417 (TID/SNA-287) NRDS TEST CELL "A" NERVA TURBOPUMP 65MM BEARING TEST FACILITY REQUIREMENTS. Facility Requirements Document. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 26p. Dep. NTIS $4.50.

The Test Cell "A" facility and special equipment requirements necessary to support the evaluation testing of LH_2 cooled 65mm roller bearings for the NERVA turbopump are presented. (TFD)

22418 (TID/SNA-301) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Material Selection, Quality Assurance, and Fabrication Evaluation, F008-NAS01-W224, Appendix G. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 29p. Dep. NTIS $4.50.

Design, quality assurance, and material selection for the exhaust duct component of the NASS are discussed. (TFD)

22419 (TID/SNA-302) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Conceptual Design Drawings and Layout, F008-NAS01-W224, Appendix H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 12p. Dep. NTIS $4.00.

The list includes drawings of duct arrangement, collar, primary ejector, carrying truss, plenum, water injection system, deflector plate, plenum support, steam system, secondary ejector, work platforms, and various miscellaneous drawings. A total of 187 drawings is listed. (TFD)

22420 (TID/SNA-313) M001-TRU04-W236a2: DESCRIPTION OF THE HYPERTHERMAL ENVIRONMENT SIMULATOR (HES), A ONE-MEGAWATT PLASMA GENERATOR FACILITY. Gracey, C. M.; Jassowski, D. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 28p. Dep. NTIS $4.50.

The Hyperthermal Environment Simulator (HES) is a high-pressure one-megawatt plasma gas generator capable of providing rocket-engine gaseous combustion products at heat-transfer conditions similar to full-scale rocket conditions. In recent years its use as a rocket-engine simulator has extended material technology and system designs considerably. Also, along with the many test programs conducted have come new innovations to the HES system which have extended the operational capability of the unit as well as lowered test costs. To acquaint others with these advances and to assist them in their future test programs, a brief synposis of the operational and performance aspects of the HES is reported. (auth)

22421 (TID/SNA-360) NERVA DESIGN CRITERIA: ETS-1 TEST STAND CONTROL SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 May 1965. 79p. Dep. NTIS $7.00.

The prime purpose of the Test Stand Control System is to operate the facilities and engine controls that interface directly with the engine and to provide the operating controls for the facility and engine. (TFD)

22422 (TID/SNA-425) FACILITY REQUIREMENTS DOCUMENT: NRDS TEST CELL "C" SINGLE NERVA TURBOPUMP FACILITY, F004-CP091149AG1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 52p. Dep. NTIS $5.75.

Basic facility requirements needed to scope the facility engineering and modification activities related to the NERVA single turbopump testing to be conducted at Test Cell "C" are given. (auth)

22423 VIBRATIONS OF THICK PLATES USING A HIGH PRECISION TRIANGULAR ELEMENT. Venkateswara Rao, G.; Venkataramana, J.; Prakasa Rao, B. (Structural Engineering Division, Vikram Sarabhai Space Centre, Trivandrum-695022, India). Nucl. Eng. Des.; 31: No. 1, 102-105(Nov 1974).

Vibrations of thick plates using a high precision triangular element are studied. The effect of transverse shear is included in the derivation of the stiffness matrix and the effect of rotatory inertia is included in the derivation of the mass matrix of the element. Explicit expressions for stiffness and mass matrices of the element are presented. The numerical examples considered show that the natural frequencies obtained are accurate even with a course finite element subdivision. (auth)

22424 FINITE ELEMENT ANALYSIS OF LINEAR AND NONLINEAR HEAT TRANSFER. Wilson, E. L.; Bathe, K. J.; Peterson, F. E. (California Univ., Berkeley (USA)). Nucl. Eng. Des.; 29: No. 1, 110-124(Nov 1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The finite element method is rapidly becoming a popular procedure for the evaluation of thermal stresses in complex structures. In linear analysis the method has been used extensively and has been coupled with stress analysis computer programs in order to automate thermal stress analysis. However, for the method to be effective, efficient numerical techniques need to be used. The purpose of this paper is to survey the recent developments in linear heat transfer analysis and, specifically, to present the techniques that permit the practical analysis of large and complex three-dimensional heat conduction problems. Typical practical problems are described and solution times are presented. In the analysis of systems with nonlinear thermal properties the

method has had limited application. In this paper the general formulation of the incremental equations used in nonlinear heat transfer analysis are presented. An efficient numerical solution of the equations is given. Several types of nonlinearities are discussed and the solutions of some typical problems are presented. (auth)

22425 A SIMPLE "MIXED" METHOD FOR PLATE AND SHELL PROBLEMS. Giencke, E. (Technische Univ. Berlin (F. R. Germany)). Nucl. Eng. Des.; 29: No. 1, 141-155(Nov 1974). From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Plates and shells are usually analyzed by the finite element method, and particularly by the deformation method. In this method the most interesting interior forces and moments are obtained as differences of the unknown deformations, which often leads to a considerable loss in accuracy. To avoid this loss in accuracy, the interior forces and strains are introduced as unknowns directly. These forces and strains as well as the geometrical curvatures of the shell and loads will be approximated linearly from point to point. The structures may be divided into triangular and rectangular elements. The interior forces and strains do not satisfy the equilibrium and compatibility conditions, and therefore equilibrium and compatibility equations have to be formulated as in a mixed method. This is done by means of the principles of virtual work, but in a very simple manner, for example as virtual displacements rigid body motions of the elements are chosen. The interior forces act only along the grid lines, thus it is quite simple to establish the equations. By using the duality between bending and stretching, the amount of computer programming is reduced. Both problems can be treated with the same program, which must be slightly extended for application to shallow shells. In the case of the deformation method the stiffness matrices for stretching and bending unfortunately have a quite different structure and it is not easy to develop simple stiffness matrices for double curved shells. Furthermore, the stretching and bending stresses have different approximations and they are discontinuous at the boundaries of the elements. In the method described in this paper each stress and strain has the same approximation with no discontinuities at the boundaries of the elements. Results are shown for stress problems in plates and shells. (auth)

22426 VISCOUS MELT FLOW AND THERMAL ENERGY TRANSFER FOR A ROCK-MELTING PENETRATION. McFarland, R. D.; Hanold, R. J. Paper No. 74-WA/HT-38. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The objective of the Subterrene program is to develop new, innovative systems for drilling and excavation based on the rock-melting concept. The basic operation of a melting penetrator in porous rock where the molten debris from the hole is disposed of by density consolidation is treated. Using a simplistic conduction analysis, optimum penetrator geometries are derived for the restricted case where local density consolidation prevails. The general problem is then formulated in terms of the two-dimensional Navier Stokes equations, energy equation, and the continuity equation with temperature dependent properties. These equations are cast in a general curvilinear, orthogonal coordinate system which corresponds to the typical melting penetrator shape. The equations are solved numerically and calculated results for required heated surface power, required thrust load, and the melt layer thickness distribution for a given penetration rate and surface temperature are presented for some typical penetrator geometries. (auth)

22427 LASER PHYSICS. Sargent, M. III; Scully, M. O.; Lamb, W. E. Jr. Reading, MA; Addison-Wesley Publishing Company, Inc. (1974). 456p. (ISBN-0-201-06718-8; ISBN-0-201-06719-6). $22.00.

The text treats the interaction of radiation with matter, paying particular attention to the laser. Existing laser media are intrinsically quantum mechanical and are most easily studied with the quantum theory. Accordingly, the book uses quantum mechanics and increases understanding of that subject in the process. In fact, the material constitutes a viable applied alternative for the usual second and third semesters of quantum mechanics. The text format lends itself quite well to reference use, particularly with regard to the fundamental concepts of laser physics. There is leeway for some detailed extensions, notably in the problems, but generality has been deliberately sacrificed for the sake of clarity. An understanding of the simpler theories enables one to work with the more general extensions available in the original literature or to treat new problems oneself. The reader can obtain from the book not only an increased understanding of the laser, but also a more profound comprehension of many-system physical phenomena in general. The material can be covered in two semesters or, alternatively, the first part (Chapters 1–13) can be used as a one-semester course in which quantum mechanical aspects of the electromagnetic field are ignored. Each chapter is accompanied by problems which illustrate the text and give useful (occasionally new) results. (auth)

22428 VIBRATIONS OF AN INTERMEDIATELY SUPPORTED U-BEND TUBE. Lee, L. S. S. (Chalk River Nuclear Labs., Ont.). J. Eng. Ind.; 97: No. 1, 23-32(Feb 1975).

Vibrations of an intermediately supported U-bend tube fall into two independent classes as an incomplete ring of single span does, namely, the in-plane vibration and the coupled twist-bending out-of-plane vibration. Natural frequencies may be expressed in terms of a coefficient p which depends on the stiffness ratio k, the ratio of lengths of spans, and the supporting conditions. The effect of the torsional flexibility of a curbed bar acts to release the bending stiffness of a straight beam and hence decrease the natural frequency. Some conclusions for an incomplete ring of single span may not be equally well applicable to the U-tube case due to the effects of intermediate supports and the presence of the supporting straight segments. Results of the analytical predictions and the experimental tests of an intermediately supported U-tube are in good agreement. (auth)

22429 ADVANCES IN APPLIED MECHANICS. Volume 12. Yih, C. S. (ed.). New York; Academic Press, Inc. (1972). 257p. $16.00.

The book consists of four articles entitled: Finite Element Methods in Continuum Mechanics; The Motion of Bubbles and Drops Through Liquids; Shock Waves, Jump Relations, and Structure; and Interplanetrary Gas Dynamics. The last article has been previously abstracted for NSA. For an abstract of this paper see 28: 25463. (TFD)

22430 APPLICATION OF SPIRAL WOUND GASKETS FOR LEAK-TIGHT JOINTS. Stevens-Guille, P. D.; Crago, W. A. Paper No. 74-WA/PVP-5. New York; American Society of Mechanical Engineers (1974). 5p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Spiral wound gaskets are composite structures made by winding a preformed metal strip and filler material over a mandrel. They are widely used in pressure vessel and piping construction, and particularly for nuclear service. They are suited for use in assemblies subject to pressure and temperature cycling, shock and vibration. Power utilities and nuclear vessel manufacturers use them in water cooled reactors in preference to any other type of gasket. Results of tests on stainless steel and asbestos spiral wound gaskets in pressurized water systems are reported in an attempt to provide designers with new information on their characteristics. (TFD)

22431 CONDUCTION PUMP FOR LIQUID METAL. Ertaud, A. (to Groupement Atomique Alsacienne Atlantique). Canadian Patent 957,005. 29 Oct 1974.

The disclosure relates to a conduction pump for liquid metal, which may be immersed in the said metal, and comprises first magnetic circuit provided at its upper part with a first feed winding and at its lower part with an air gap in which a horizontal magnetic field is set up; a rectilinear duct having a vertical axis crossing the air gap used for the liquid metal flow; a coil whose middle plane is horizontal, constituted by a refractory casing containing liquid metal in electrical contact at the level of the air gap with the liquid metal flowing in the duct: a second magnetic circuit provided, at its upper part with a supply winding inducing an electric current in the coil, the direction of that current being horizontal and orthogonal to the magnetic field in the section of liquid metal situated in the air gap. The coil is arranged below the first and second windings and the said casing is connected to the duct by two end pieces each comprising at least one opening allowing the inside of the casing to communicate with the inside of the duct. (CA)

Lasers

22432 (AD-777960) CARBON MONOSULFIDE AND CO PROBE LASER RESEARCH. Final Technical Report, 15 June 1972–31 July 1973. Jeffers, W. Q.; Powell, H. T. (McDonnell Douglas Research Labs., St. Louis, Mo. (USA). Radiation Sciences Dept.). 31 Jul 1973. Contract N00014-72-C-0458. 80p. NTIS $7.00.

The subject contract was divided into two major efforts, i.e., (1) an investigation of CS-fueled CO chemical lasers, and (2) ex-

perimental measurements of CO vibrational relaxation by means of probe laser transient gain experiments. (auth)

22433 (AD-778018) TUNABLE 10 MICRON LASER, AN INTEGRATED OPTICS APPROACH TO INFRARED GAS LASERS. Final Technical Report, 1 June 1972–31 December 1973. McMullen, J. D.; Davis, R. L. (Rockwell International Corp., Anaheim, Calif. (USA). Electronics Research Div.). 28 Feb 1974. Contract N00014-72-C-0505. 70p. NTIS $3.75.

The development of an integrated optics approach to a tunable CO_2 laser for application as a master oscillator or local oscillator employing a hollow planar waveguide structure is described. Laser operation has been demonstrated using a planar waveguide with transverse flow and transverse excitation, longitudinal flow and longitudinal excitation, all of which have had thickness dimensions between 470 and 1000 microns with pressures near 80 torr. The above lasers have employed spherical and cylindrical Fabry-Perot reflectors. (auth)

22434 (AD-779916) INFRARED LASERS AND INFRARED SPECTRA OF FREE RADICALS. Annual Report. Powell, F. X. (Catholic Univ. of America, Washington, D. C. (USA). Dept. of Chemistry). 23 Apr 1974. Contract N00014-67-A-0377-0010. 23p. NTIS $3.00.

The reaction of NO with active nitrogen produces excited species which can transfer energy to CO_2 yielding laser lines at 10.6 micrometers. It has been demonstrated that the reaction of N atoms with NO yields N_2 in a vibrationally excited state. It has also been demonstrated that the discharge parameters are critical and that different discharges produce species which can energize the laser in various ways. (auth)

22435 (AD-780103) ELECTROSTATIC COOLING OF LASER MIRRORS AND WINDOWS. Final Report, 20 March 1973–15 February 1974. Kibler, K. G.; Carter, H. G. Jr. (General Dynamics Corp., Fort Worth, Tex. (USA). Convair Aerospace Div.). Apr 1974. Contract F29601-73-C-0057. 143p. (AFWL-TR-73-298). NTIS $4.75.

Investigations were conducted to determine the mechanism of electrostatic cooling and to optimize its application for laser mirrors and windows. Electrostatic cooling in air is found to be essentially an ionic drag phenomenon in which the convective heat transfer coefficient is proportional to the fourth root of corona current. Results of samples of ZnSe, Al, and cervit, ranging from 1.5 to 4-in. dia, indicate that convective cooling by electric probes in air is generally 10 to 15 times the natural convection cooling rate. This cooling rate may be increased by another factor of 2 if a polar gas is used instead of air. A guide for the estimation of electrostatic cooling for a prescribed system is given by a theoretically-formulated approximate equation which relates heat transfer coefficients to corona current, sample size, and gas parameters. Design recommendations for applications to laser mirrors and windows are included, and several optimization techniques are suggested. (auth)

22436 (AD-780176) H_2–Cl_2 CHEMICAL LASER PROGRAM. Part II. Arc Jet Laser Experiment. Final Report, December 1972–December 1973. Reiner, R. J.; Emanuel, G.; Trost, J.; Reeve, J.; Ackerman, R. A. (TRW Systems Group, Redondo Beach, Calif. (USA)). Jan 1974. Contract DAAH01-73-C-0446. 229p. (RK-CR-74-9-PT-2). NTIS $6.00.

Work done under a program to demonstrate feasibility of a supersonic mixing laser using chain reactions of the H_2-Cl_2 system to produce vibrationally excited HCl is described. This report describes the experimental setup, test procedures and hardware operation, and results of tests carried out to date. The experiment uses arc heated diluent gas to partially dissociate chlorine. Diluent plus chlorine gas flows through a two dimensional nozzle bank and then mixes with slit injected H_2 as a free jet in a stable laser cavity. Three diluents (N_2, He, Ar) have been used in the tests with cw laser power measured using the first two. Peak power of 27 MW was detected using He diluent. Previous theoretical analysis predicted much higher powers. The reasons for the discrepancy are discussed and future experiments are suggested. (auth)

22437 (AD-780238) ELECTRON BEAM MOLECULAR LASERS. Semiannual Technical Report No. 2, 15 November 1972–15 May 1973. Byron, S. R.; Nelson, L. Y.; Fisher, C. H.; Mullaney, G. J.; Pindroh, A. L. (Mathematical Sciences Northwest, Inc., Seattle, Wash. (USA)). Aug 1973. 50p. (MSNW-74-105-2). NTIS $3.25.

The program is directed toward developing efficient, high energy density electric discharge lasers in the infrared and visible regions of the spectrum. A high current, electron-beam-stabilized, electric discharge is used for excitation. Infrared laser emission and absorption from the vibrational levels of HF (2.8 to 3.1 μ) and DF (3.8 to 4.1 μ) in various gas mixtures are being studied to determine laser efficiency and to obtain a detailed model of the vibrational kinetics. The efficiency of electric discharge excitation of molecular vibration in these gases is being determined by solving the electron Boltzmann equation. Electronic state excitation by E-beam stabilized electric discharges in N_2 and other molecular systems is being investigated in an effort to develop efficient, long pulse visible lasers. (auth)

22438 (AD-780265) HIGH POWER CO LASER. Semiannual Technical Report, 1 September 1973–28 February 1974. McAllister, G. L.; Lacina, W. B.; Rice, D. K.; Mendoza, P. J. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). May 1974. 42p. (NRTC-74-21R). NTIS $5.25.

Effort on the high power CO laser program is reviewed. The program is directed toward the development of the required CO laser technology, the required component technology, and the design and construction of intermediate power laser devices. The results of analytical and experimental investigation of the basic characteristics of the laser and data from a high pressure electrically excited CO laser device are discussed. (auth)

22439 (AD-780274) CARBON MONOXIDE LASER. Annual Technical Report. Center, R. E. (Avco-Everett Research Lab., Everett, Mass. (USA)). May 1974. Contract N00014-72-C-0030. 48p. NTIS $3.25.

The main objective was the investigation of the pulsed electrical CO laser to determine the relevant scaling parameters and the usefulness of high power CO lasers in systems applications. The current contract has included parametric multiline/multimode performance measurements, investigation of the medium homogeneity using interferometric diagnostics, calculations of CO line-shift and linewidth as a function of pressure in CO-N_2 mixtures and detailed parametric performance calculations for both single and multiline operation. The parametric performance calculations are described in an appendix to the present report and should prove to be useful for systems design considerations. The calculations have been made for single and multiline outputs as well as selected multiline output. Also included are some detailed line-shift calculations in CO-N_2 mixtures. The shifts are predicted to be less than 0.005/cm per atmosphere N_2. (auth)

22440 (AD-781997) INVESTIGATION OF THE FEASIBILITY OF A MAGNETOHYDRODYNAMIC LASER. Final Report, 3 June 1971–30 April 1974. Bullis, R. H.; Churchill, T. L.; Nighan, W. L.; Erlandsen, P. O.; Schulman, E. R. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 31 May 1974. Contract N60921-71-C-0279. 92p. (UARL-N-921308-4). NTIS $4.00.

The investigation is directed towards the evaluation of the feasibility of a magnetohydrodynamic laser concept (MHDL) employing nonequilibrium electron kinetics to provide efficient energy transfer in a molecular laser system. To achieve this goal comprehensive modeling of the MHD plasma based upon a detailed knowledge of electron and heavy particle kinetics has been developed. Experimental investigations conducted on small scale laminated and solid wall generator configurations have confirmed theoretical modeling predictions and indicate the potential attractiveness of the MHDL concept for high power laser applications. Major emphasis in the report has been placed on the additional experimental information obtained from small scale generator tests as well as experimental results obtained in a generator configuration suitable for optical power extraction investigations. (auth)

22441 (AD-782000) TUNABLE FAR INFRARED METHYL FLUORIDE LASER USING TRANSVERSE OPTICAL PUMPING. Final Report. Brown, F.; Kronheim, S.; Silver, E. (Williams Coll., Williamstown, Mass. (USA). Dept. of Physics). Dec 1973. Contract N00014-73-C-0182. 16p. NTIS $4.00.

Some severe limitations of optically-pumped superradiant FIR lasers (700 MHz line width, ragged pulse shape) may be overcome using transverse optical pumping (TOP). Strong (500 W) lines have been produced in CH_3F with linewidth <30 MHz, and cavity tuning has been achieved over a range of 460 MHz at 496 μm. Prospects for extending the tuning range and increasing the power are considered. (auth)

22442 (AD-783623) ELECTROMAGNETIC PULSE ENVIRONMENT STUDIES. Volume I. Two-Dimensional Ground-Burst Electromagnetic Pulse Calculational Methods. Final Report, 5 May 1972–31 December 1973. Dalich, S. J.; Granzow, K. D. (Science Applications, Inc., Albuquerque, N. Mex. (USA); Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Jun 1974. Contract F29601-72-C-0117. 147p. (SAI-73-514-AQ). NTIS $4.75.

A description of the physics and numerical methods used in two-dimensional ground burst electromagnetic pulse calculations is given. In particular the SCX code, one of two computer codes which performs such calculations, is described. The source terms, air chemistry, and boundary conditions are also discussed. Multipole expansion techniques for outer boundary conditions are described in detail. Comparisons between the SCX code and the LEMP1 code are presented. Instructions for running SCX are contained in an appendix. (auth)

22443 (AD-784750) GROWTH AND HARDENING OF ALKALI HALIDES FOR USE IN INFRARED LASER WINDOWS. Quarterly Technical Report. Butler, C. T.; Martin, J. J.; Merkle, L. D.; Sibley, W. A.; Sill, E. L. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). 31 Jul 1974. Contract F19628-72-C-0306. 13p. NTIS $3.00.

A reactive atmosphere processing Bridgman KCl crystal growth system has been placed in operation. This system uses the now conventional CCl_4 treatment method. The resultant undoped KCl crystals show a 10.6 micrometer absorption of 0.0004/cm. Flow stress measurements as a function of radiation damage on KBr(x) I(1-x) crystals have been started. A system for measuring the flow stress as function of temperature has been completed. (auth)

22444 (AD-784760) METAL OXIDATION LASER. Murray, L. G. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1974. 73p. (NPS-57CO74061). NTIS $3.75.

Thesis.

Experiments were conducted with the CO_2-CH_3N_3 laser to determine if a chemical laser is feasible using a pumping scheme where energy released by photolysis of CH_3N_3 is used to create a population inversion in CO_2. A metal oxide laser system was designed and constructed. The energy from an exothermic chemical reaction between a metal and an oxidizing gas was used to create a population inversion in the diatomic product molecules. The metal was vaporized using the exploding wire technique. The laser tube, resonant cavity, vacuum system, electrical control system and exploding wire circuit were designed and fabricated. Several experiments were performed using aluminum, copper, and indium wire with oxygen gas. (auth)

22445 (AD-784774) STUDY OF MOLECULAR LASERS. Semiannual Technical Report, 1 October 1973-31 March 1974. Wolga, G. J.; McFarlane, R. A.; Bauer, S. H.; Cool, T. A. (Cornell Univ., Ithaca, N. Y. (USA)). Jul 1974. 31p. NTIS $3.25.

Research performed at Cornell University aimed at furthering the understanding of energy transfer and deactivation mechanisms in chemical and molecular lasers as well as the study of new laser systems and new chemical sources for laser system is described. The methodology employed consists of laboratory experiments, data analysis including computer modeling, and literature review. Work is reported in several areas: (1) measurement of the vibrational deactivation of HF(v = 1), CO_2(001) and CO (v = 1) by collisions with atoms. The atoms employed were H, F, O, N, D, Cl; (2) measurement of the rate of vibrational deactivation at low temperature of the bending mode of CO_2 (010) by argon; (3) completion of a complete computer model for the CS_2-O, CO chemical laser system; (4) study of new H atom sources for HF lasers; and (5) laser double resonance studies of vibration to rotation energy transfer in HF. (auth)

22446 (AD-784828) ATMOSPHERIC PRESSURE H_2-F_2 LASER INITIATED BY ELECTRON-BEAM IRRADIATED DISCHARGE. Hofland, R.; Ching, A.; Lundquist, M. L.; Whittier, J. S. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Jul 1974. Contract F04701-74-C-0075. 18p. NTIS $3.00.

Pulse energy and power versus time for the output of an HF laser pumped by the H_2-F_2 chain reaction were measured. Noble-gas-diluted atmospheric pressure mixtures were initiated uniformly with the use of a transverse electrical discharge established by partially ionizing the gas mixture with a burst of high energy electrons. As primary objectives, the authors sought to demonstrate atmospheric pressure operation and a laser output comparable to the electrical energy supplied for initiation. Performance as a function of several parameters was studied. (GRA)

22447 (AD-784862) ANALYSIS OF TURBULENT SHEAR FLOWS IN LASER NOZZLES AND CAVITIES. Interim Report, February-May 1974. Varma, A. K.; Sullivan, R. D.; Beddini, R. A. (Aeronautical Research Associates of Princeton, Inc., N. J. (USA)). May 1974. Contract F44620-73-C-0027. 29p. (ARAP-221). NTIS $3.25.

An invariant second-order closure program for compressible shear flows was developed. The program was applied to study a simulation of the mixing region in a HF chemical laser. Considerable insight into the complex processes occurring in laser cavities has been achieved by these studies. The results show that the assumptions used in the eddy viscosity and the turbulent kinetic energy closure methods are not completely valid for non-equilibrium flows such as in the chemical laser system. The results of studies of other shear flows with the same invariant second-order model are in generally good agreement with experimental measurements, but suggest the need for improvement of the pressure diffusion model for high speed compressible flows. (auth)

22448 (AD-784885) DYE TESTING AND EVALUATION PROGRAM. Final Technical Report, 1 May-31 December 1973. Ladd, G. O. Jr. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). May 1974. F33615-73-C-1149. 93p. (UARL-N-921681-9). NTIS $4.00.

Optimization of the performance of laser dyes emitting in the range from 590 to 750 nm was investigated in the proprietary vortex stabilized flashlamp pumped dye laser developed by United Aircraft Research Laboratory. The long life and extremely repeatable output characteristics of the flashlamp permit an extended investigation for the purpose of comparing the performance of twenty dye-solvent combinations. The dyes evaluated were rhodamine 6G, rhodamine B, kiton red S, and cresyl violet nitrate which were prepared in a pure form by the Air Force Materials Laboratory. Another dye evaluated was Eastman Kodak No. 1188, oxazine perchlorate. Degradation tests were performed on the most efficient dye solvent combinations to determine their suitability for sustained operation. (auth)

22449 (AD-784930) DEVELOPMENT OF A MINIATURIZED DYE LASER. Interim Report, 10 June-10 August 1974. Glenn, W. H. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 8 Aug 1974. Contract N60921-74-C-0339. 11p. (UARL-N-921952-1). NTIS $3.00.

The objective of this program is to develop a miniaturized dye laser suitable for a variety of applications, particularly in an underwater environment. Emphasis to date has been placed on the following tasks: evaluation of pump cavity configurations; investigation of increased flashlamp input energy; and testing of various dyes in aqueous solutions. A summary of the results of these investigations followed by a brief outline of plans for continuing work in the next reporting period are presented. (GRA)

22450 (AD-784991) HIGH-ENERGY LASER WINDOWS. Semiannual Report No. 4, 1 January-30 June 1974. Rice, R. W. (Naval Research Lab., Washington, D. C. (USA)). 30 Jun 1974. 103p. NTIS $4.50.

The following topics are discussed: characterization of strontium-doped KCl forgings; crack propagation in KCl; 10.6 micrometer irradiation damage in press forged KCl; fracture of ZnSe and As_2S_3; theory of intrinsic multiphonon absorption and comparison with experiment; impurity effects on vacuum ultraviolet and infrared multiphonon spectra of laser window materials; surface finishing of fluoride laser windows; spectral emittance studies of surface and bulk absorption; new instrumentation; and separation of surface and bulk absorption in laser calorimetry. (GRA)

22451 (AD-785021) MONOLITHIC LASER. Annual Technical Report, 1 May 1973-30 April, 1974. Blum, F. A.; Lawley, K. L.; Watts, R. K.; Doerbeck, F. H.; Scott, W. C. (Texas Instruments, Inc., Dallas (USA)). Jun 1974. Contract N00014-73-C-0288. 56p. (TI-08-74-46). NTIS $3.75.

Research to develop the first prototype integrated optical transmitter is reported. The effort has involved the development of a unique (Ga,In)As surface laser and high index infrared glass waveguides. Ternary alloy $Ga_{1-x}In_xAs$ mesas with $0 < x < 0.2$ have been grown and the details of their morphology determined. Also, a GaAs mesa diode laser was successfully fabricated. The p-n junction was formed by Zn diffusion into the top of the mesas. The diode mesa laser is the first monolithic, nondiscrete injection laser ever made. It is the only diode laser ever completely fabricated (including optical cavity formation) monolithically using conventional photolithographic fabrication technology. Finally, high quality chalcogenide glass optical waveguides have been developed. Losses as low as 0.4 db/cm were measured in sputtered As_2S_3 films. Channel optical stripline waveguides were fabricated by overlaying photoresist strips on the glass films. Low-loss channel waveguiding was observed in these structures. (auth)

22452 (AD-785180) FREQUENCY TUNED CO_2 LASER. Final Technical Report, 19 March 1973-30 June 1974. Abrams, R. L.; Klein, M. B. (Hughes Research Labs., Malibu, Calif. (USA)). Aug 1974. Contract N00014-73-C-0324. 106p. NTIS $8.50.

The program represents an effort to exploit the advantages of wave guide laser technology for the development of advanced components suitable for optical radar applications. These include a

CO_2 laser local oscillator, tunable plus or minus 750 MHz from line center for heterodyne detection of Doppler shifted signals, and an intermediate level power amplifier. A parametric study of tunable wave guide lasers is described in which tube geometry, gas mixture, and mirror mount design were all varied to determine the optimum design for frequency tunability and stability. The final device consists of a 1.0-mm square by 9.5-cm long wave guide laser with 80 MW output power, 1.2 GHz tunability, and < 10 KHz short term frequency stability. A 1.65 mm i. d. × 1 m wave guide amplifier test bed was constructed with an active gain length of 77 cm. The specific trade-offs involved in designing a full scale device which achieves the required output power and bandwidth are discussed. (auth)

22453 (AD-785234) ARPA–NRL LASER PROGRAM. Semiannual Technical Report, 1 Jul–31 December 1973. Airey, J. R.; Champagne, L.; Djeu, N.; Green, W. H.; Hancock, J. K. (Naval Research Lab., Washington, D. C. (USA)). Jul 1974. 64p. (NRL-MR-2846). NTIS $3.75.

The ARPA-NRL high energy laser program is concerned with the development of laser technology in three project areas: chemical infrared lasers, electrical infrared lasers, and electronic state lasers. The chemical infrared laser program is concerned with the development of the DF-CO_2 supersonic transfer chemical laser, the study of the CO vibrational distribution from exothermic reactions which produce CO and the measurement of energy transfer rates of CO. The objective of the DF-CO_2 program is the chemical augmentation of gasdynamic CO_2 lasers. V-V and V-R,T energy transfer rates have been measured for CO-additive mixtures and the temperature dependence of some of these rates has been investigated. The electrical infrared laser program consists of two primary projects, short-pulse CO_2 laser technology and electric-discharge gasdynamic lasers (EDGDL). Advances in pulse switch out technology and measurements of gain profiles and spectral content are reported. Components for an EDGDL apparatus for the investigation of the D_2–HCl transfer laser have been fabricated and are being assembled. (auth)

22454 (AD-785277) INVESTIGATION FOR IMPROVING LIFE OF A HIGH POWER, SHORT PULSE, DYE LASER PUMP LAMP. Final Report, April 1973–June 1974. Eckel, R. A. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). Aug 1974. Contract N00123-73-C-1148. 39p. (R-ILC-74-4). NTIS $3.25.

The purpose of the program was to improve the useful life of a linear pulsed light source for pumping dye lasers. The lamp arc length was 2 in. The operating conditions were as follows: pulse length 2 microsec pulse energy 4J, pulse repetition rate 220 pps, desired useful life 8,000,000 pulses. Performance data for a "standard" lamp was established. The cathode and the method of operating the lamp appear to be the most important factors in extending lamp life. It was also found that a higher lamp fill pressure and a smaller diameter lamp bore improved the lamp output. (GRA)

22455 (AD-785400) EXPLORATORY STUDIES OF DIF-FUSION LASER MODIFICATIONS. Spencer, D. J. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Aug 1974. Contract F04701-74-C-0075. 25p. (SAMSO-TR-74-196). NTIS $3.00.

The report is a summary of three exploratory studies of the gas composition modification in a conventional continuous-wave HF (DF) chemical diffusion laser. Experiments were performed in the aerospace diffusion laser test facilities. The substitution of HBR fuel for H_2, DF/CO_2 transfer performance in a triple-slit nozzle array, and CO_2 mixing laser performance with the triple-slit nozzle used were of concern in these experiments. (GRA)

22456 (AD-786026) MEASUREMENT OF THE RATE OF DISSOCIATIVE ATTACHMENT OF ELECTRONS TO FLUORINE IN A FLOWING AFTERGLOW SYSTEM. Interim Technical Report, January 1973–January 1974. Sides, G. D.; Tiernan, T. O. (Aerospace Research Labs., Wright-Patterson AFB, Ohio (USA)). Jul 1974. 70p. (ARL-74-0105). NTIS $4.25.

The dissociative attachment of low energy electrons to fluorine is a potential source of fluorine atoms in electrically initiated hydrogen-fluorine chemical laser systems. The ARI flowing afterglow system was developed to measure the rate of this reaction. Electrons are produced in a microwave discharge and react with fluorine, and the resulting negative ions are sampled through an orifice at the end of a reaction channel. Two other reactions were also studied in the process of developing the experimental technique, i.e., the charge transfer reaction between diatomic negative oxygen ion and sulfur hexafluoride and electron attachment to sulfur hexafluoride. (auth)

22457 (AD-786030) DEVELOPMENT OF POLYCRYSTALLINE ALKALI HALIDES BY STRAIN RECRYSTALLIZATION FOR USE AS HIGH ENERGY INFRARED LASER WINDOWS. Final Technical Report, February–October 1973. Kulin, S. A.; Neshe, P. P.; Kreder, K. (Manlabs, Inc., Cambridge, Mass. (USA)). Jan 1974. Contract F33615-73-C-5078. 51p. (AFML-TR-74-17). NTIS $4.25.

The compressive deformation processing of pure KCl and KCl single crystals alloyed with Ru, Rb or Br was investigated. The variables evaluated in this infrared alloy window fabrication process included temperature, total strain, strain rate, heating and cooling cycles, and quality and orientation of the single crystal starting material. Experimental conditions required to produce crack-free windows were established. Mechanical testing and microstructural observations were performed on such windows. This work has shown the feasibility of producing KCl alloy windows having high mechanical strengths. Further, processing conditions were developed which appear to establish the feasibility of scale-up for the fabrication of windows of very large sizes. (auth)

22458 (AD-786232) HIGH POWER DYE LASERS. Semiannual Report No. 8, 1 March–30 September 1974. Murey, W. W.; Glenn, W. H. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 30 Sep 1974. Contract N00014-73-C-0284. 54p. (UARL-N-921617-8). NTIS $4.25.

Modifications made to the previously reported high power dye laser to allow for increased power handling capability, repetition rate and operating times are reported. Present problems are primarily involved with dye circulation and heat dissipation and the solution to these should lead to powers output from the dye laser that are well in excess of the presently available level of 41 W. Sections cover the following: design and testing of new flashlamps; theory of power distribution in flashlamp; rotary spark gap; ray tracing program; and dye flow system and laser power measurements. (GRA)

22459 (AD-786507) HIGH RADIANCE FLASHLAMP PUMPED DYE LASER. Final Technical Report. Ewanizky, T. F. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Sep 1974. 21p. (ECOM-4260). NTIS $3.25.

A negative-branch, confocal unstable resonator has been found to significantly improve the beam quality of a coaxial flashlamp pumped rhodamine 6G dye laser. In a performance comparison with a conventional parallel-plane mirror resonator, over an order of magnitude increase in laser beam radiance has been measured. The negative-branch unstable resonator demonstrated relatively uncritical alignment sensitivity, a major practical advantage for field application. (auth)

22460 (AD-786775) TUNABLE OPTICAL SOURCES. Final Report, 1 July 1972–30 June 1974. (Stanford Univ., Calif. (USA). Microwave Lab.). Aug 1974. 21p. (ML-2338; AROD-7580.20-P). NTIS $3.25.

New techniques for the development of sources of tunable radiation and for spectral up-conversion of both incoherent and coherent infrared sources are discussed. Emphasis has been placed on the infrared region of the spectrum. Substantial progress has been made in the general areas of nonlinear optical materials, optical parametric oscillators, and nonlinear optical techniques in metal vapors and gases. Abstracts are given for all publications which have appeared or will appear under this grant. (auth)

22461 (AD-787079) STUDIES OF E-BEAM PUMPED MOLECULAR LASERS. Technical Report No. 3, 1 July 1973–30 June 1974. See Also Report Dated 30 June 1973, AD-766158. Hill, R. M.; Gutcheck, R. A.; Huestis, D. L.; Mukherjee, D.; Lorents, D. C. (Stanford Research Inst., Menlo Park, Calif. (USA)). 31 Jul 1974. 67p. (SRI-MP-74-39). NTIS $4.25.

Experimental and theoretical studies which examine the feasibility of attaining laser action in high pressure gas mixtures (in particular Ar + N_2 + NC) excited by electron beam pulses are described. Using photometrical and photographical means, 14 reaction rate coefficients for this system were measured. It was determined that there exists large populations of metastable excited N_2 (implying long-lived high energy storage capacity). A kinetic model program describing the complex interaction of the gases was developed which agrees well with experiment. This model can predict potential laser efficiencies of the following N_2 transitions: an efficiency of almost 1% for the 2+ (0–1) band, 1.8% for the 1+ (0–0) band, and the possibility of efficient lasing in the V–K system. (auth)

22462 (AD-787317) PRODUCTION ENGINEERING MEASURE FOR OPTICAL PUMPS FOR LASERS. Quarterly Report No. 3, January–March 1974. See Also Report Dated 1 February 1974, AD-785596. Maynard, R.; Sowers, H. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). Aug 1974. 31p. (R-ILC-73-22/Q3). NTIS $3.75.

The program is directed towards establishing a capability for manufacturing flashlamps to be used as optical pumps in liquid cooled and gas cooled laser systems. The work carried out during the third quarter of the program is described. Testing was carried out on the fully developed liquid cooled lamps (pump 1). Samples of a near optimal design of a gas cooled lamp (pump 2) were fabricated and tested. First engineering test samples (ETS) of pump 1 and pump 2 have been submitted for evaluation. Modifications to the GFP unit designated for fluorescent analysis measurements were completed. Additional modifications have been made to the high speed data acquisition and recording system supplied by ILC. The ILC laser to be used for testing pump 1 was evaluated for efficiency. A shock and vibration fixture has been designed and completed for testing pump 2. Engineering drawings for pump 1 and pump 2 have been completed. A production route sheet that is used in the maufacture of the lamps has been computed. (auth)

22463 (AD-787404) NON-LINEAR NARROW RESONANCES OF THE DENSITY OF EXCITED MOLECULES IN A STANDING-LIGHT WAVE. Letokhov, V. S.; Pavlik, B. D. (AN SSSR, Moscow. Otdelenie Obshche) Fiziki i Astronomii). 18 Sep 1974. Translation of Preprint No. 8. (FTD-MT-24-1844-74). 32p. NTIS $3.75.

The possibility of the resonant variation in the total number of particles on the excitation level with the transmission of the field frequency through the center of a Doppler-widened absorption line was examined. The article examines the effect of the formation of the resonance of the total number of particles in the simplest mode of the moving two-layer particles with a varied degree of saturation of absorption, and also the effect of rotational relaxation on the value of the resonance in the case of molecular transitions. (GRA)

22464 (IPP-4/121) TEA CO_2 OSCILLATORS FOR THE PRODUCTION OF 1 NSEC PULSES IN ONE-LINE, MULTILINE, AND TWO-BAND OPERATION. Baumhacker, H.; Brinkschulte, H.; Fill, E.; Lang, R. S. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Aug 1974. 52p. (In German). Dep. NTIS (US Sales Only) $5.75.

Several TEA CO_2 oscillators which produce short single pulses of about 1.2 ns duration are described. The energy of one short pulse is 20 to 30 mJ, which corresponds to a power of 17 to 25 MW. The beam divergence is 1.6 to 2 mrad and therefore nearly diffraction limited. The short pulses are generated both actively by acousto-optic mode-locking techniques and passively by mode-locking by means of nonlinear absorbers. By inserting spectrally selective absorbers in the resonator and using a spectrally controlled pilot oscillator it is possible to achieve multiline oscillations on the P- and R-branches of the 10.4 μm and/or 9.4 μm band. (auth)

22465 (JPRS-63804) CHARACTERISTICS OF VOLUME DISCHARGE EXCITED BY A 10^{-6} SECOND DURATION ELECTRON BEAM. Bychkov, Yu. P.; Genkin, S. A.; Korolev, Yu. D.; Kreyndel, Yu. E.; Mesyats, G. A.; Filonov, A. G. Translated from Zh. Eksp. Teor. Fiz.; 66: No. 2, 622-625(1974). 5p. NTIS.

Results of an investigation of the volume discharge produced by a beam of fast electrons with a duration of 10^{-6} are presented. The volt-ampere characteristics in $CO_2:N_2$ were determined for various pressures and discharge power input characteristics. The conditions under which the volume discharge is stable (does not change to arc discharge) are determined. (auth)

22466 (JUL-1125-PP) ELECTRON-BEAM-CONTROLLED CO_2-LASER. Mioduszewski, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Oct 1974. 39p. (In German). Dep. NTIS (US Sales Only) $5.00.

For the excitation of CO_2-lasers with pulse-energies up to kilojoules the discharges are required to have large energy input per volume at low E/p-values and at pressures ≥1 bar. In large volumes such discharges can only be established by the external ionization of the gas. For this purpose a suitable electron beam generator with a pulse-heated tungsten filament cathode was built. At excitation durations of some microseconds electron densities of about 10^{13} cm^{-3} could be achieved in the laser gas. With an electric field of 4 kV/cm in the gas volume the energy input was 200 J/l. The attempt was made to get information about the electron loss mechanism from the current time history that results after the electron beam has been switched off. Volume recombination, that is proportional to the square of the electron density as the only relevant loss mechanism could not be approved experimentally. Operating the laser as an oscillator pulses with energies of some joules have been obtained out of a volume of 0.6 l. (auth)

22467 (KFKI-74-71) DISTRIBUTED FEEDBACK DYE LASER OF WAVELENGTH TUNABLE FROM 7470 A TO 8400 A. Bakos, J. S.; Fuezessy, Z.; Soerlei, Z.; Szigeti, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 5p. Dep. NTIS (US Sales Only) $4.00.

A 10^{-3} mol/liter solution of DDI 1,1'-diethyl -2,2'-dicarbocyanine iodide was used in distributed feedback configuration for lasing. The operation characteristics of the laser, the range, the line-width, the output power-pumping light power function, near and far field patterns were investigated. (auth)

22468 (N-74-27004) DEVELOPMENT OF ULTRAVIOLET LASERS. Final Report. Walters, G. K. (Rice Univ., Houston, Tex. (USA). Dept. of Physics). 15 Apr 1974. 3p. (NASA-CR-138632). NTIS $4.00.

The pulsed electron accelerator selected for use in the development of ultraviolet laser capability suitable for use in photoexcitation and photoionization studies of the upper atmosphere is reported. Performance figures, installation specifications, and total cost of the equipment are briefly shown, and plans for further studies are outlined. (STAR)

22469 (UCRL-75184(Rev.2)) CONDITIONS FOR X-RAY LASER ACTION. Chapline, G.; Wood, L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1974. 15p. Dep. NTIS $4.00.

Necessary and sufficient conditions for using atomic transitions to produce x-ray laser action are reviewed. It is shown that it will be very difficult to produce laser action for photon energies above a few kilovolts. (auth)

22470 CHARGE STORAGE IN INJECTION LASERS AND ITS EFFECT ON HIGH-SPEED PULSE MODULATION OF LASER DIODE. Lee, T. P.; Derosier, R. M. (Bell Labs., Holmdel, NJ). Proc. IEEE (Inst. Elec. Electron. Eng.); 62: No. 8, 1176-1177 (Aug 1974).

Charge storage in injection lasers under transient forward bias has been found to be responsible for the difference in the observed threshold for a driving current pulse with and without another pulse preceding it. Estimated relative threshold currents of two successive pulses as a function of pulse spacing based on the charge storage model agreed reasonably well with the experiment. (auth)

22471 SURFACE HEATING OF METALLIC MIRRORS IN HIGH POWER LASER CAVITIES. Chun, K. R. Paper No. 74-HT-A. New York; American Society of Mechanical Engineers (1974). 5p. $3.00.

The effect of the absorptance increase with the rising mirror surface temperature on the final surface temperature is examined. For noble metals such as silver, copper, and gold, the Drude theory predicts an approximately linear dependence of the normal spectral absorptivity on the temperature in an absolute scale for the wavelengths 1 to 15 μ and the temperatures 100 to 1200°K approximately. For such a regime, it is shown that gross underestimates of the final surface temperature rise result from the assumption of the constant absorptivity at the initial temperature when the estimated value becomes comparable to the initial temperature in an absolute scale. (auth)

22472 ELECTRON DISTRIBUTION FUNCTION IN THE ELECTRIC DISCHARGE OF A LASER MIXTURE, INCLUDING CO, UNDER CONFINEMENT CONDITIONS. Vasiliu, V. (Inst. of Atomic Physics, Bucharest); Novgorodov, M. Z.; Sviridov, A. G.; Sobolev, N. N. Stud. Cercet. Fiz.; 26: No. 4, 355-359 (1974). (In Rumanian).

The electron distribution function in the case of plasma mixtures used in CO lasers ($CO-N_2-He$ and $CO-N_2-Xe-He$) under the condition of no gas circulation is presented. The electron energy distribution function was drawn up resorting to a recording scheme which is based on the second derivative of the electrical sounder current against voltage supply via the second harmonics method. The experimental data obtained pointed out the special role played by Xe in the mechanism of the distribution function changing as well as the phenomenon of excitation rate growing of the first 8 vibration levels of the CO molecule. (auth)

22473 CARBON MONOXIDE LASER. Vasiliu, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 4, 407-421(1974). (In Rumanian).

Worldwide results concerning CO laser research are presented. The principal laser operation parameters as power, resonator size, working regime are reported. The fact that CO laser emits a radiation spectrum in the range from 5 to 6 μm is indicated as well as the circumstance according to which the number of emission lines depends on the cavity used in the experiment, on the working regime, as well as on the mixture composition. The role of certain components of the mixture in the power growing of the laser is equally stressed. (auth)

22474 STUDY OF THE CHARACTERISTICS OF A RUBY LASER WITH AN OPTICAL DELAY LINE. Klochan, Ye. L.; Korniyenko, L. S.; Kravtsov, N. V.; Lariontsev, Ye. G.; Popova, M. I. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 19: No. 1, 83-90(Jan 1974).

Translated from Radiotekh. Elektron.; 19: No. 1, 111-118 (Jan 1974).

The properties of a ruby laser with an optical delay line in the free-lasing mode of operation have been investigated theoretically. Some time, energy and spectral characteristics of the laser are calculated for cavity lengths from 3 to 500 m. The calculation results are compared with experimental data. (auth)

22475 UNIDIRECTIONAL GENERATION IN A RING SOLID-STATE LASER. Klochan, E. L.; Kornienko, L. S.; Kravtsov, N. V.; Lariontsev, E. G.; Shelaev, A. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 215: No. 2, 313-316(11 Mar 1974). (In Russian).

A theoretical and experimental study was made of the conditions for the existence and stability of a regime of unidirectional generation in ring solid-state lasers. The results obtained led to the conclusion that such a regime can be obtained under the following conditions: change of the coupling of the counter wave during tuning of the resonator both because of reverse reflections and because of diffraction effects, introduction of a non-symmetric reverse coupling by use of a supplementary mirror, and resolution of the frequency of the circular resonator for the counter wave. (JSR)

22476 SPONTANEOUS MODE LOCKING IN A LASER WITH A MULTIFACETED ELEMENT. Kamenskii, E. I.; Kozlov, V. V. (Moscow State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 831-832(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1323-1326(June 1974).

A laser with a multifaceted element operating in the mode-locked regime is investigated experimentally. A stable train of equally spaced pulses is obtained with an individual pulse width of ~2 nsec, a pulse separation of 13 nsec, and a peak power of ~15 MW. The reproducibility of the time trace and modulation character of the giant pulses is 95%. The investigated laser has the advantages of small physical size (~18 cm) combined with large optical length for the cavity (~200 cm). (auth)

22477 KINETICS OF GASDYNAMIC LASERS. Effect of Nozzle Geometry on Inversion. Biryukov, A. S.; Shelepin, L. A. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 775-781(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1232-1243(June 1974).

A detailed analysis is made of the effect of supersonic nozzle geometry on the parameters of a CO_2 gas-dynamic laser. It is shown that each of the elements characterizing the nozzle (throat half-height of radius, divergence angle of expansion section, length and shape of expansion section, character of the transition from subsonic to supersonic flow, and so on) has its own specific effect on the population inversion and the kinetics of vibrational relaxation. A study is also made of the case of high (up to ~4000°K) initial temperatures, allowing for the variation of the composition and the gasdynamic parameters as a result of chemical reactions. It is shown that equilibrium reactions do not lead to additional nonequilibrium effects in the vibrational levels. Such nonequilibrium effects can result from the combustion of carbon-containing mixtures. (auth)

22478 LASING PROPERTIES OF Yb^{3+} AND Er^{3+} GLASS LASER PUMPED BY A LASER. Kalinin, V. N.; Mak, A. A.; Prilezhaev, D. S.; Fromzel, V. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 835-836(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1328-1331(June 1974).

Lasing at 1.54 μ is obtained in silicate and phosphate glasses activated by Yb^{3+} and Er^{3+} and pumped by a neodymium laser at 1.06 μ. Induced absorption of pump radiation resulting from the excitation of the $^4I_{13/2}$ level in Er^{3+} ions is investigated. When the Yb–Er glass specimens are placed in the pump cavity the pump spectrum shifts towards long wavelengths. These effects reduce the efficiency of the laser. (auth)

22479 HIGH ENERGY LASERS AND THEIR APPLICATIONS. Jacobs, S.; Sargent, M. III; Scully, M. O. (Univ. of Arizona, Tucson). Phys. Quantum Electron.; 1: 1-411(1974).

This is the first volume of a new serial publication, "Physics of Quantum Electronics." The contributions are based on lectures presented by well-known scientists at the Physics of Quantum Electronics Summer School. This first volume concentrates on high energy lasers and their applications, notably on laser-induced fusion. The first chapter gives background theory for understanding laser operation with intense fields. The derivations are couched in intuitive terms, but nevertheless follow fairly rigorously from the underlying quantum mechanical foundations. A number of new strong-signal formulas are presented, with graphs to illustrate tuning and pumping behavior. The second chapter deals with a very promising method of treating the unstable resonator, a device important for high energy laser operation due to the increased mode volume obtained. This method, too, is developed from first principles. Chapter 3 deals with amplifier theory in some detail, treating numerous amplifier configurations and media. After developing the theory in a fashion parallel to the laser treatment in Chapter 1, the author considers applications to molecular and solid-state lasers currently being used in fusion studies (discussed later in the volume). Chapter 4 deals with the propagation of intense laser beams in the atmosphere paying particular attention to problems of thermal blooming and atmospheric turbulence. Chapter 5 discusses the population inversion mechanisms in three important high power gas lasers: CO_2 electrical, CO_2 gas dynamic, and HF chemical. The final three chapters of the book deal with laser-induced fusion. Chapter 6 gives a review of the basic concepts including an overview of the various international efforts to achieve this important phenomenon. Chapter 7 deals with the properties of lasers, both in principle and (present) practice that are relevant to inducing fusion. The final chapter presents a "back of the envelope" calculation that reveals the various orders of magnitude involved in laser fusion. (TFD)

22480 NONSTATIONARITY OF THREE-MODE EMISSION IN TRAVELING-WAVE AND STANDING-WAVE GAS LASERS. Zeyger, S. G. pp 340-346 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation of the nonstationarity of three-mode emission in traveling-wave and standing-wave gas lasers was made. The effect of nonstationarity was observed in a standing-wave helium-neon laser with wavelength of 0.63 μm at a pressure of 2 mm Hg. At lower pressures (1.6 mm Hg) the mode was self-sunchronized with phase π, while at higher pressures the mode was self-synchronized in-phase. It was established that in a standing-wave laser the region of nonstationarity is considerably greater than in a traveling-wave laser. The results are discussed. (Referativnyi Zh.)

22481 MAGNETIC FIELD CONTROL OF THE EMISSION CHARACTERISTICS OF A RUBY LASER. Valyavko, V. V.; Boyko, B. B. pp 125-145 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

A study was made of the problem of controlling the emission characteristics of a ruby laser by using a magnetic field. It is concluded that a pulsed magnetic field with an intensity of 10^5 oersteds [7.8×10^6 A/m] has a noticeable influence on the operation of a ruby laser at close to room temperatures. By appropriate selection of the intensity, duration, and time of activation of the magnetic field pulse one can increase the emission energy both in the mode of spontaneous emission and in the accumulative mode in a scheme with passive shutter. Besides, using a magnetic field without other selecting systems one can shift the wavelength of the stimulated emission to the short wavelength side up to 6 Å. (Referativnyi Zh.)

22482 HIGH-FREQUENCY AUTOMODULATION OF EMISSION OF A LASER WITH TRANSLUCENT FILTER. Samson, A. M.; Kotomtseva, L. A.; Milinkevich, A. V. pp 62-99 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

To solve the problem of self-modulation of a laser with a translucent filter the authors propose using nonstationary equations of radiation transport and probabilistic equations for the populations of the energy levels of the active substance and the filter. It was found, in particular, that reasons for self-modulation consist in nonsimultaneous action on the medium of emission coming into the investigated volume from various points of the cavity. The resultant analytical estimates are illustrated by computer solution of the initial system of equations for ring and linear lasers. (Referativnyi Zh.)

22483 DYE LASER WITH CONTINUOUS TUNING IN THE 360 TO 1000 NM SPECTRAL RANGE. Loyko, M. M.; Mostovnikov, V. A.; Rubinov, A. N.; Motkin, V. S. pp 30-40 of Kvantovaya Elektronika i Lazernaya Spektroskopiya. Minsk; Nauka i Tekhnika (1974). (In Russian).

The Raduga-3M laser instrument is described. The operating principle of the laser is based on the effect of emission from

solutions of complex organic compounds when they are stimulated by emission on the fundamental (λ = 694 nm) or doubled (λ = 347 nm) frequency of a ruby laser. The device provides fairly powerful laser emission of any wavelength in the spectral range of 360 to 1000 nm with continuous tuning of the emission line, and is intended for use in various areas of spectroscopy, nonlinear optics, photochemistry, biology and medicine. (Referativnyi Zh.)

22484 CONCERNING THE QUESTION OF STABILITY OF A SINGLE-FREQUENCY TRAVELING-WAVE LASER. Milovskii, N. D.; Popova, L. L. pp 356-361 of Lazery s Perestraivayemoy Chastotoy. Kiev; Naukova Dumka (1973). (In Russian).

An investigation was made of the influence which mismatch ($\delta = \Omega - \Omega_0$) between the frequency of the monochromatic field (Ω) and the frequency of the center of the line of the active substance (Ω_0), and the parameter $\Omega_0\beta$ which characterizes the nonuniform broadening of the luminescence line, have on the critical excess λ_g. The study used a one-dimensional model of a traveling wave laser with losses uniformly distributed throughout the cavity volume, and a nonuniformly broadened active medium. An examination was made of the influence of the mismatch δ on the stability of a single-frequency laser on a uniformly broadened active substance ($\Omega_0\beta = 1$), and the effect of nonuniform broadening on the quantity λ_g in the simplest special case $\delta = 0$. The results are discussed. (Referativnyi Zh.)

22485 INVESTIGATION OF A CO_2 LASER STIMULATED BY A SHORT-DURATION ELECTRON BEAM. Bychkov, Yu. I.; Kurbatov, Yu. A.; Mesyats, G. A. pp 134-139 of Moshchnyye Nanosekundnyye Impul'snyye Istochniki Uskorennykh Elektronov. Novosibirsk, USSR; Izdatel'stvo Nauka (1974). (In Russian).

The results of a study of different working modes of a carbon dioxide electroionization laser stimulated by a short-duration electron beam are given. Curves for the pumping energy and emission energy as functions of E_0/p, the concentration of the working mixture, its pressure, and also the amplitude of the injection current are discussed. An analysis of the results shows that it is feasible to operate at low current injection densities $(1 \text{ to } 5) \times 10^4$ A/m^2, but in the presence of ionization amplification in the active region. The energy contribution to the gas space was calculated. Recommendations are made on choosing the parameters of the discharge circuit. For short delays ($< 10^{-6}$ s) in spark breakdown the presence of a spark in the cavity appreciably reduces emission energy, although pumping energy in this case remains fairly high. (Referativnyi Zh.)

22486 HOLLOW COLD CATHODE FOR HELIUM-NEON LASERS. Kucherenko, E. T.; Deryugin, I. A.; Zykova, E. V. USSR Patent 338165. 8 Jan 1973. Filed Date 24 Jul 1970. (In Russian).

A hollow cold cathode is proposed for helium-neon lasers. To reduce dimensions and extend service life, the cathode is made up of several cylindrical tubes having longitudinal slits and fastened on the inside of a cylindrical mandrel. This design appreciably increases the inner surface of the cathode and creates interconnected cavities, each of which is a hollow cathode. The inside of the cathode can be coated with a layer of electrically positive substance having high resistance to ion bombardment, e.g., barium scandate. (Referativnyi Zh.)

22487 OBSERVATION OF LASER ACTION IN CO GAS EXCITED ONLY BY FISSION FRAGMENTS. McArthur, D.A.; Tollefsrud, P.B. (Sandia Laboratories, Albuquerque, New Mexico 87115). Appl. Phys. Lett. 26: No. 4, 187-190 (15 Feb 1975).

We report the first clear observation of laser action in a medium excited only by fission fragments. CO gas at 77 °K and pressure $\simeq$100 Torr was excited by fission fragments from enriched $^{235}U_3O_8$ foils, which were irradiated with neutrons from a fast-burst reactor. The laser signal was $\gtrsim 10^3$ times the fluorescence signal, disappeared if the laser output mirror was misaligned, and had a very sharp onset and fall. The measured laser pulse energy was 10 times the maximum possible fluorescence energy. (auth)

22488 SELF-GUIDING FLASHLAMP-PUMPED DYE LASERS. Burlamacchi, P.; Pratesi, R.; Ronchi, L. (Laboratorio di Elettronica Quantistica del C.N.R., Via Panciatichi 56/30, 50127 Firenze, Italia). Appl. Opt. 14: No. 1, 79-93 (Jan 1975).

A simple analysis of light amplification in media with inhomogeneous profile of the complex refractive index is carried out. The results are used to account for the waveguide effects observed in superrandiant dye lasers with flashlamp excitation and to discuss the basic operations of some new dye laser configurations recently developed. (auth)

22489 EFFECT OF GENERATION OF HARD x RAYS OF MICROSECOND DURATION ON A TARGET TO Q SWITCHING OF A LASER BY A PLASMA MIRROR. Batanov, V.A.; Gochelashvili, K.S.; Ershov, B.V.; Malkov, A.N.; Kolisnichenko, P.I.; Prokhorov, A.M.; Fedorov, V.B. (P. N. Lebedev Physics Institute, USSR Academy of Sciences). JETP Lett. 20: No. 6, 185-187 (20 Sept 1974).

When the radiation of a neodymium-glass laser operating in the millisecond-pulse regime was focused on a soild target and in air, generation of "giant" microsecond pulses was observed as a result of the Q switching of the laser by the produced plasma mirror. Microsecond-duration laser plasma that generates hard x rays with electron temperature $T_e \simeq 2-4$ keV in air and $T_e \simeq 3-7$ keV on a polyethylene target, was obtained experimentally for the first time. We investigated the reflection, transparency, and gasdynamics of the obtained plasma. (auth)

22490 FREQUENCY LOCKON OF A SOLID-STATE LASER WITH AN INHOMOGENEOUS BROADENED SPECTRAL LINE OF AMPLIFICATION IN A REGIME OF FREE GENERATION BY AN EXTERNAL FORCE. Bocharov, V. V.; Zubarev, I. G. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 7, 964-969(1974). (In Russian).

Frequency lockon of a solid-state Nd-glass laser by an external force was accomplished. It is shown that in concrete systems the lockon band is $\lesssim 10$ cm^{-1}. An energy gain $>10^2$ was experimentally obtained when the spectrum was narrowed more than 10 times. A block diagram is shown of the experimental equipment which includes a narrow-band laser ($\Delta\nu \lesssim 0.01$ cm^{-1}). The experimental results are in qualitative agreement with current theory. (JPRS)

22491 DIRECT NUCLEAR PUMPING OF A HELIUM-XENON LASER. Helmick, H.H. (Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Fuller, J.L.; Schneider, R.T. Appl. Phys. Lett. 26: No. 6, 327-328 (15 Mar 1975).

Excitation of a He-Xe laser was achieved by nuclear pumping, i.e., fission products interacted directly with the lasing gas and a portion of their energy was emitted as laser light. The transition observed is most likely the Xe $5d[7/2]^0_3 - 6p[5/2]_2$, 3.508 μm. The He-Xe gas mixture ratio was 20 : 1 at a total pressure of 200 Torr. The light output exhibited a threshold effect and had the same characteristic waveform as the fission fragment flux above the threshold level. Laser output duration was approximately 150 μsec. (auth)

22492 A SIMPLE, RELIABLE WAVEGUIDE DYE LASER FOR OPHTHALMOLOGICAL APPLICATIONS. Burlamacchi, P. (Istituto di Ricerca sulle Onde Elettromagnetiche del C.N.R., Firenze, Italy); Pratesi, R.; Vanni, U. Rev. Sci. Instrum. 46: No. 3, 281-283 (Mar 1975).

The principle of operation, construction, and performance of a compact waveguide dye laser, especially designed as a source of retinal photocoagulators, are described. The guiding effects produced by the thermal gradients induced by the pumping pulse and the use of closed resonator make the laser very reliable, simple, and with good pulse repeatibility. The construction is very simple and inexpensive. Except for flashlamps, which are commercial, no part of the laser requires sophisticated technology to be built or assembled, neither optical components have critical flatness and need careful alignment. The system does not need cooling, and slow recirculation of the solution, necessary to replace the degraded dye in the waveguide, is provided by a magnetically coupled 0.1 W electric motor. The dye cell, pump, and dye reservoir form a single component of the laser which can be easily extracted for inspection and replacement of the dye solution. The single, regular pulse emitted by the laser, its time duration (a few microseconds), the possibility to operate the laser at the absorption peaks of the ocular tissues make the laser better than the random spiking "passive" ruby laser or than the "explosive" Q-switched ruby laser for ophthalmological applications. If connected with a slit lamp, the laser should compete with the much more expensive ion gas lasers. Good retinal photocoagulations have been made in rabbits using a solution of Rhodamine 6G in ethanol. Retinal spots of rectangular shape of variable dimension but of constant energy density have been produced by simply masking the exit window of the laser. (auth)

22493 PERFORMANCE OF A LASER MIRROR HEAT PIPE. Jacobson, D. L. Paper No. 74-WA/HT-61. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

The design and testing of a cylindrical copper-water heat pipe for application to an optically flat end for laser beam reflection is described. The heat pipe is 2 in. in dia and 3 in. in length. The wick consists of sintered copper screen-covered grooves. The evaporator end of the device was heated by electrical resistance wires or by a carbon arc solar simulator. Heat was removed at the condenser end by a circumferential water calorimeter. The device was instrumented internally and externally with Cu-Cn thermocouples. Reflecting surface distortions were measured from the highly polished heat pipe end by a focal length change method. The heat pipe demonstrated the ability to significantly

reduce surface deflections and therefore laser beam distortion. When the heat pipe was heated from ambient conditions to 285 W at 154 W/cm², the measured distortion was 0.08 (λ/4) 10.6μ ± 0.06 (λ4)10.6μ. When the heat pipe was preheated by electrical resistance wires, no change in focal length was detected. Subsequent thermal tests at 235 W/cm², the power flux limit of the simulator, showed that the limiting heat pipe heat flux was apparently not exceeded. (auth)

22494 PROSPECTS FOR A GAMMA-RAY LASER. Baldwin, G. C. (Rensselaer Polytechnic Inst., Troy, NY); Khokhlov, R. V. Phys. Today; 28: No. 2, 32-39(Feb 1975).

From 8th international conference on quantum electronics; San Francisco, CA (Jun 1974).

The possibility of developing a gamma-ray laser by finding ways to achieve Moessbauer transitions and population inversion simultaneously in nuclear isomers is discussed. (TFD)

22495 PUMPING OSCILLATOR FOR SEMICONDUCTOR LASERS. Popkov, A. V. pp 23-28 of Tekhnologiya Proizvodstva Kosmicheskoy Apparatury. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An examination is made of a miniature current pulse generator circuit. A type MTKH-90 cold-cathode thyratron was used as the current commutator. In the self-oscillatory mode on a frequency of 380 Hz the oscillator develops a current of up to 100 A in a pulse in a 1 Ω control space. Pulse duration is controlled over a range from 0.1 to 3.0 μs. (Referativnyi Zh.)

22496 PULSE GENERATION IN A CW DYE LASER BY MODE-LOCKED SYNCHRONOUS PUMPING. Harris, J. M.; Chrisman, R. W.; Lytle, F. E. (Purdue Univ., Lafayette, IN). Appl. Phys. Lett.; 26: No. 1, 16-18(1 Jan 1975).

A continuous train of <500 ps (detector limited) pulses was produced with a cw dye laser pumped by a mode-locked argon ion laser. The cavity lengths of the dye laser and argon laser were made equal in order to synchronously amplify a single pulse oscillating in the dye laser. An intracavity acousto-optic modulator was used to dump dye laser pulses at rates as high as 10 MHz. (auth)

22497 INFLUENCE OF EXCITED SINGLET ABSORPTION ON OUTPUT POWER OF CW DYE LASERS. Teschke, O.; Dienes, A. (Univ. of California, Berkeley). Appl. Phys. Lett.; 26: No. 1, 13-15(1 Jan 1975).

The effects of the absorption of the pump light by the first excited singlet state on the output of a Rhodamine 6G cw dye laser were investigated. Experimental results show a change in the incremental photon efficiency with pump wavelength. Theoretical expressions are derived for the output power, including the effects of excited state absorption. By matching experimental and theoretical results, values for the excited state absorption cross sections are found at four different wavelengths. (auth)

22498 ELECTRON-BEAM-EXCITED DFB LASER IN CdS. Aoyagi, Y.; Namba, S. (Inst. of Physical and Chemical Research, Wako, Japan). Appl. Phys. Lett.; 26: No. 1, 24-26(1 Jan 1975).

Distributed feedback (DFB) laser oscillation under electron-beam excitation was observed in CdS. The linewidth of the laser spectrum was found to be less than 0.8 Å. Compared to a conventional laser, the spectrum was less sensitive to temperature. The DFB lasing was observed to occur only at the start of the excitation pulse and the pulsewidth was much shorter than that of a conventional laser. (auth)

22499 STIMULATED EMISSION OF CRESYL VIOLET PUMPED BY N_2 LASER OR RHODAMINE 6G DYE LASER. Castelli, F. (Univ. of Arizona, Tucson). Appl. Phys. Lett.; 26: No. 1, 18-19 (1 Jan 1975).

Cresyl violet solutions have been shown to lase when pumped with a N_2 laser or a rhodamine 6G dye laser. In the latter case the efficiency is much higher, and for appropriate solution concentrations the dye lases at the wavelength peak of its spontaneous emission. Under these conditions, the gain is so high that superradiance is obtained using only a 10-kW exciting pulse with 10% lasing efficiency. (auth)

22500 HIGHLY COLLIMATED LASER BEAMS FROM ELECTRICALLY PUMPED SH GaAs/GaAlAs DISTRIBUTED-FEEDBACK LASERS. Scifres, D. R.; Burnham, R. D.; Streifer, W. (Xerox Palo Alto Research Center, CA). Appl. Phys. Lett.; 26: No. 2, 48-50(15 Jan 1975).

Utilizing an electrically pumped single-heterostructure GaAs/GaAlAs distributed-feedback laser diode operating in fourth order, a highly collimated laser beam which is coupled out normal to the plane of the p-n junction rather than through the cleaved end mirrors was obtained. This beam is found to have an angular divergence of 0.35° in the dimension determined by the grating and is virtually 100% polarized with the E vector parallel to the grooves of the corrugated feedback structure. (auth)

22501 PULSED DOUBLE-HETEROSTRUCTURE GaAs DIODE LASERS IN FLEXURAL AND LONGITUDINAL VIBRATIONS. Keller, R.; Voumard, C.; Weber, H. (Univ., Bern). Appl. Phys. Lett.; 26: No. 2, 50-52(15 Jan 1975).

The deformation behavior of pulsed double-heterostructure diode lasers at both mirror and contact surfaces was investigated by means of an interferometric technique. The diodes, which were only supported by the pressure of a wire connection, showed at the end of a current pulse an elongation and deflection behavior. Longitudinal and flexural vibrations of the diodes were measured after the application of a single current pulse and for the flexural vibrations a resonance behavior was observed during a current pulse train. (auth)

22502 THERMAL INSTABILITY IN HIGH-POWER LASER DISCHARGES. Jacob, J. H.; Mani, S. A. (Avco-Everett Research Lab., Everett, MA). Appl. Phys. Lett.; 26: No. 2, 53-55 (15 Jan 1975).

The thermal and acoustic instabilities that could possibly cause arcing in high-power pulsed and cw gas lasers have been investigated. A cubic dispersion relation is obtained from linearization of the coupled hydrodynamic and Ohmic equations in which the electrical conductivity is dependent on the neutral density. It was found that when the thermal wave is unstable the acoustic waves are damped, and vice versa. The growth rate of the instability is proportional to the power density for low input powers while it goes as the cube root of the power density for high input powers. (auth)

22503 HETEROSTRUCTURE $CdS_{1-x}Se_x$ – CdS SURFACE LASERS FOR INTEGRATED OPTICS. Kawabe, M.; Kotani, H.; Masuda, K.; Namba, S. (Osaka Univ.). Appl. Phys. Lett.; 26: No. 2, 46-48(15 Jan 1975).

Heterostructure $CdS_{1-x}Se_x$ – CdS surface lasers which have a larger refractive index and a smaller band gap than CdS substrates were fabricated by vapor phase epitaxy and their laser characteristics at 80 K were studied by using a nitrogen gas laser excitation. The Se profiles which were deduced from the fluorescence wavelength were steplike but graded due to diffusion. The optical gain of the epitaxially grown surface layer was larger than that of CdS single crystal owing to optical confinement. By stripe geometry excitation, an intense axial single-mode output was observed up to the excitation intensity three times as high as the threshold 70 kW/cm². Optical coupling between the active and passive layers was observed in the samples which have a double epitaxial layer. (auth)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstracts 24160 and 24161.

22504 (AD-768222) FABRICATION OF A LIGHTWEIGHT SUPERCONDUCTING MHD MAGNET. Final Report, September 1970–May 1973. Gluck, D.; Atherton, D. L. (Ferranti-Packard Ltd., Toronto (Canada)). May 1973. Contract F33615-69-C-1212. 77p. (AFAPL-TR-73-63). NTIS $3.75.

The details of fabricating a lightweight superconducting magnet suitable for a portable magnetohydrodynamic (MHD) project are presented. Problems in winding of the pancake coils, bending of the coil ends to a saddle form and bonding of the insulation were overcome by controlled dimensioning and variable fixturing. Pre-impregnated E glass filament strands are used for the former and hoops. Construction techniques are illustrated. Epoxy fiberglass cloth end plates and glass filament ties are used to restrain the end repulsive forces. Basic differences of the actual magnet fabricated and the final design conception (reference design 69) are included together with additional stress and heat calculations for the dewar and magnet system. (auth)

22505 (AD-787593) SUPERCONDUCTING QUANTUM DEVICES. Final Report, 1 January 1970–30 June 1974. (Harvard Univ., Cambridge, Mass. (USA). Div. of Engineering and Applied Physics). 31 Aug 1974. 17p. NTIS $3.25.

The research program proposed and carried out was broadly aimed at the practical development and application of superconducting quantum devices. The major result was the successful use of these devices in ultrasensitive voltmeters and magnetometers, and the determination of the theoretical and practical limitations of these instruments in their original and subsequently improved forms. In addition, the electrical behavior of superconducting microbridge weak links was studied to understand aspects of their

physical behavior with important device implications. Most of this work has been reported previously in the technical reports listed in the report. Finally, the authors explored the possible use of novel instrumentation and of closed-cycle cryogenic refrigerators in connection with superconducting quantum devices and reached negative conclusions as to their usefulness in the program. (GRA)

22506 (AD-787660) ELECTROCALORIC REFRIGERATION FOR SUPERCONDUCTORS. Semiannual Technical Report. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 30 Jun 1974. 49p. NTIS $3.75.

The goal of the program is to demonstrate the feasibility of a refrigerator based on the electrocaloric effect. It is planned to develop a prototype refrigerator which will absorb on the order of 1 watt at 4°K and have an upper reservoir temperature of 15°K. Applied research has been carried out mainly in two areas, (1) the glass-ceramic dielectric materials to be used as the refrigeration element and (2) heat switches to allow the cyclic refrigeration unit to be operated in a continuous manner. (GRA)

22507 (COM-74-10757-04) SUPERCONDUCTING DEVICES AND MATERIALS. A Literature Survey Issued Quarterly October–December 1974. Issue No. 74-4. Olien, N. A.; Goree, W. S.; Nisenoff, M. (National Bureau of Standards, Boulder, Colo. (USA). Inst. for Basic Standards). 1974. 77p.

An extensive list of current references on superconducting theory, materials, properties, devices, machines, and applications is presented. An author index is included. (WHK)

22508 JOSEPHSON DEVICE PARAMETRONS. Zappe, H. H. (to International Business Machines Corp.). US Patent 3,863,078. 28 Jan 1975. Filed date 14 Mar 1973. 18p.

Josephson tunneling devices are used as parametrons in circuits for logic and memory. Parametron circuits are used as input devices to conventional pulsed Josephson tunneling device circuitry, and as output devices from pulsed Josephson tunneling device circuitry. Therefore, transfers from phase information to pulse information and from pulse information to phase information are obtained. Interconnection between superconducting circuit chips is achieved using Josephson tunneling parametrons and Josephson tunneling detectors. Another interconnection scheme uses capacitive coupling between superconducting circuit chips without physical interconnections therebetween, and employs Josephson tunneling devices on separate chips for the receiving and sending circuitry. (Official Gazette)

22509 CRYOGENIC ASPECTS OF SUPERCONDUCTING ELECTRICAL MACHINES FOR SHIP PROPULSION. Mole, C. J.; Litz, D. C.; Feranchak, R. A. Paper No. 74-WA/PID-9. New York; American Society of Mechanical Engineers (1974). 12p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Comprehensive studies have been performed on complete propulsion systems, including liquid helium refrigeration support equipment, to determine overall size and weight of such systems. Developments of high specific horsepower superconducting propulsion systems require machine designs with thermodynamic optimum cryogenic conditions as well as acceptable machine efficiency. Westinghouse has designed, built, and tested two superconducting a-c generators. Th results of superconducting propulsion design studies and the experience developed on the Segmag machines are summarized. (auth)

22510 LOW TEMPERATURE THERMAL CONDUCTIVITY MEASUREMENTS ON LONGITUDINAL AND TRANSVERSE SECTIONS OF A SUPERCONDUCTING COIL. Hust, J. G. (National Bureau of Standards, Washington, DC). Cryogenics; 15: No. 1, 8-11(Jan 1975).

Thermal conductivity measurements have been performed on longitudinal and transverse sections of a superconducting coil at 5, 79, 196, and 276 K. The composite coil sections are composed of copper-stabilized niobium–titanium wire embedded in epoxy. Tabular and graphical data are presented. These data are compared to values calculated on the bases of components of the coil sections. Reasonably good agreement is obtained. (auth)

22511 INDUCTIVE REACTANCES OF A CRYOGENIC SYNCHRONOUS MACHINE IN TRANSIENT AND ASYMMETRIC WORKING MODES. Bertinov, A. I.; Mironov, O. M.; Mokin, V. S. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 5, 103-107(1973). (In Russian).

The inductive reactances of inverse and zero sequences and the superconductive mode of a cryogenic synchronous machine without ferromagnetic core were determined. The calculations were done for machines with inside and outside location of the inductor. The calculations also enable determination of the inductive reactance of a machine with a cylindrical ferromagnetic core located inside the winding of the armature. It is shown that the inductive reactances can be represented as a series with terms corresponding to the space harmonics of the armature reaction fields. The inductive reactances of the inverse and zero sequences and the superconductive mode decrease as the damper nears the armature winding, as the thickness of the winding increases, and as the number of poles of the machine increases. (JPRS)

22512 CIRCUIT FOR SWEEPING THE FIELD OF A SUPERCONDUCTING SOLENOID. Lybzikov, G. F.; Zeer, E. P. (Inst. of Physics, Moscow). Cryogenics; 14: No. 11, 619-620(Nov 1974).

In certain applications it is necessary to sweep the field of a superconducting solenoid. A circuit is given for achieving this in which the current in the sweep-winding of the solenoid can be varied smoothly from −2.5 to +2.5 A. The total change in current in the load corresponds to an overall sweep of 200 Oe with a nonlinearity $\ll 0.4\%$. (UK)

22513 QUENCHING OF LARGE SUPERCONDUCTING COILS. Mulhall, B. E. (Univ. of Warwick, Coventry, Eng.); Prothero, D. H. Cryogenics; 15: No. 1, 31-34(Jan 1975).

The growth of a normally conducting region in a superconducting coil is related to the propagation of such a region along a superconducting wire. The theory is compared with observations on two large coils which incorporated close coupled secondary windings, so that the voltage across the normal region could be observed directly. Reasonable agreement is found. (auth)

22514 ELECTROMAGNETIC FIELD AND AC LOSS ENHANCEMENTS IN A LAYER OF SUPERCONDUCTING ROUND WIRES. Ward, D. A.; Bray, R. J. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 15: No. 1, 21-24(Jan 1975).

Recent designs for a superconducting power transmission cable consider a flexible system in which the current is carried in a layer of wires or strips, each having a superconducting surface, laid on the surface of a tube. Subdivision of the conductor in this way causes an enhancement of electric and magnetic fields, and of ac losses. The case considered here is when the individual conductors are round wires. Field enhancements are calculated and used to determine ac loss enhancements. These are averaged over the conductor surface to give an overall loss enhancement factor for the cable. Results are presented to cover a wide range of situations. (auth)

22515 SUPERCONDUCTING QUADRUPOLE MAGNETIC LENS WITH 30 MM APERTURE. Geraskin, E. V. (United Inst. of Nuclear Studies, Dubna, USSR); Grebinnik, V. G.; Shukov, V. A.; Manych, A. P.; Malyaev, V. K.; Selivanov, G. I. Cryogenics; 14: No. 11, 628-630(Nov 1974).

It is expedient to use a superconducting system of quadrupole lenses for focussing and directing hyperon beams obtained from an accelerator. For relatively small transverse and longitudinal dimensions high magnetic field gradients can be provided. Since it is not possible to make a sufficiently correct calculation of such a system without a knowledge of the focussing properties of the quadrupole lenses, which depend to a great extent on the characteristics of the superconducting and magnetic materials used, a model of an element of the focussing system has been made with a 30 mm aperture. Details of the construction are given. Details are also given of the measuring unit containing bismuth wire probes used to measure the magnetic field gradient. Variation of the magnetic field strength along the aperture radius and along the lens axis are shown. (UK)

22516 PHYSICS OF RESISTIVE SQUIDS MODULATED AT LOW FREQUENCY. Park, J. G. (Imperial Coll. of Science and Tech., London). J. Phys., F (London); 4: No. 12, 2239-2263(Dec 1974).

Starting from first principles the mechanisms are considered which underlie the response of resistive SQUIDS (superconducting quantum interferometers) to magnetic flux produced by modulation current i_0' flowing in a coil, or to current I passed through the normal region of resistance R from an external current source. If I_0' changes at a constant rate $di_0'/dt = \alpha$ the output voltage v_r oscillates just as it does in the presence of a current I. It is shown why the frequency of oscillation f, when I = 0, should have the same value $\alpha M/\phi_0$ as it would for a SQUID of the same dimensions when α is sufficiently large, but have a lower value, no longer proportioned to α, when $f^{-1} \sim \tau'$. Here τ' is a time longer than the time constant $\tau(\tau = L/R$, where L is the inductance of the R SQUID) and is a function of the level of RF excitation. Likewise, when $\alpha = 0$, the frequency of oscillation of v_r produced by current I deviates from the Josephson voltage frequency relation $f = IR/\phi_0$ when $f^{-1} \sim \tau'$. It is thus possible to provide a plausible explanation for a result

obtained by Harding and Zimmerman (J. Appl. Phys.; 41: 1581 (1970)), which was surprising at the time: they could observe no dependence of f/α on α even when f^{-1} was more than 30τ. The present results also point to a possible source of error in noise thermometers that depend on fluctuations in f due to Johnson noise in the resistance. The close analogy between the RF excited R SQUID or SQUID and the same structure without RF excitation, but with a much feebler weak link, is pointed out. I_s, the critical current of the latter, depends on the level of RF excitation. τ' is directly related to I_s: $\tau' \simeq (\phi_0/2\pi)/I_sR$ and will be much larger than τ when I_s is small. In general, writing $V_s = (M\alpha - IR)$ where M is the mutual inductance between coil and R SQUID, the frequency f becomes appreciably smaller than V_s/ϕ_0 when $V_s \sim I_sR$ and zero when $V_s < I_sR$. Deviations of f from the value V_s/ϕ_0 should be clearly detectable and not obscured by noise as long as $I_s > 0.01$ 3T μA, where T is the absolute temperature. (auth)

22517 SHIELDING PROPERTIES OF SUPERCONDUCTING SHIELDS. Bondarenko, S. I.; Vinogradov, S. S.; Gogadze, G. A.; Perepelkin, S. S.; Sheremet, V. I. (Physicotechnical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 824-828(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1312-1320(June 1974).

A theoretical and experimental study was made of the effect of the shape of a superconducting shield on its shielding properties. Axisymmetric shields (cylindrical shield with a bottom or spherical shield with a circular aperture) are shown to be effective. The calculated shielding coefficients agree with the experimental data. (auth)

22518 DESIGN AND PERFORMANCE OF A 30 1 h^{-1} HELIUM LIQUEFIER/REFRIGERATOR WITH PLASTIC PISTON EXPANSION ENGINES. Nagano, H. (Tokyo Univ.). Cryogenics; 14: No. 12, 654-656(Dec 1974).

An all-welded, simplified expansion engine with plastic piston and plastic piston rings was designed and tested. With expansion engines of this type, a helium liquefier/refrigerator of 30 1 h^{-1} capacity was built and its design, performance and controls are described. The liquefaction cycle is a Claude cycle with the helium gas being purified by a low temperature purification circuit added inside the liquefier. This liquefier produced about 30,000 litres of liquid helium during a period of twelve months. (auth)

22519 CRYOSTAT AND DISCHARGE TUBE FOR INVESTIGATING ELECTRON EMISSION FROM SUPERCONDUCTING SURFACES IN ULTRA HIGH VACUUM. Cobourne, M. H.; Williams, W. T. (University Coll. of Swansea, Eng.). Cryogenics; 15: No. 1, 37-38(Jan 1975).

A discharge tube and cryostat used in a study of the rate of electron emission from the surface of tantalum electrodes immersed in a vacuum ~10^{-8} torr is described. For such an investigation an electric field >10^7 V m^{-1} is necessary between the electrodes and with such fields, currents of the order 10^{-4} A can flow between the electrodes, producing considerable heating. When investigating emission from electrodes in the superconducting state, rapid conduction of this heat away from the electrodes must be ensured in order to maintain their temperature below the transition temperature. With the apparatus described it is possible to do this and in addition, the electrodes are easily demountable, there is a variable electrode gap separation (<1 mm) with a means of setting the gap accurately parallel at room temperature and measurement of the gap at 4.2°K, continuous measurement of the temperature of the cathode is possible and the discharge tube can be evacuated to ~10^{-8} torr at room temperature. (UK)

22520 SUPERCONDUCTIVE FIXED POINTS FOR CRYOGENIC THERMOMETRY. Schooley, J. F.; Soulen, R. J. Jr. (National Bureau of Standards, Washington, DC). Instrum. Technol.; 21: No. 11, 35-39(Nov 1974).

From international conference of the Instrument Society of America; New York, NY (28 Oct 1974).

Research at NBS has shown that some elements exhibit very sharp and reproducible superconductive transitions. This research led to the development of a device, now offered through the Office of Standard Reference Materials, which permits ±0.001°K reproducibility at the superconductive transitions of Pb (T_c ~ 7.2°K), In (T_c ~ 3.4°K), Al (T_c ~ 1.2°K), Zn (T_c ~ 0.85°K), and Cd (T_c ~ 0.5°K). To extend the usefulness of the device, NBS has been examining the width and reproducibility of the superconductive transitions of Nb_3Sn (T_c ~ 18°K), Ir (T_c ~ 0.1°K), Be (T_c ~ 0.023°K), and W (T_c ~ 0.015°K) with the view of establishing these materials as additional fixed points. This article describes these superconductive fixed points. (auth)

22521 TOROIDAL WINDING GEOMETRY FOR HIGH VOLTAGE SUPERCONDUCTING ALTERNATORS. Steeves, M. M.; Kirtley, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge). IEEE Trans. Power App. Syst.; PAS-93: No. 6, 1902-1908(1974).

From IEEE Power Engineering Society winter meeting; New York (27 Jan 1974).

A modification of the Gramme-Ring armature winding is proposed for possible use in high voltage alternators. The geometry of a toroidal winding permits good management of both electric and magnetic fields within a machine. Design formulae for a superconducting alternator with a toroidally wound armature are presented, and a comparison is made between an armature designed on this principle and an existing armature for the MIT-EEI superconducting alternator. (auth)

22522 MAGNETIC SUSCEPTIBILITY MEASUREMENTS USING SUPERCONDUCTING DEVICES. Cukauskas, E. J. Charlottesville, VA; Univ. of Virginia (1974). 106p. University Microfilms Order No. 75-2040.

Thesis (Ph. D.).

The design, performance and noise analysis of a prototype superconducting susceptometer incorporating a Josephson junction magnetometer, superconducting persistent current magnet and superconducting shields is discussed in detail. Changes in susceptibility of 10^{-10} cgs can be detected with a 1 sec. system response time. The sensitivity is limited at this value by Johnson noise and thermally induced fluctuations in the nuclear paramagnetism in the copper construction material used in the low temperature environment; however it appears that it may be possible to increase the sensitivity by several orders of magnitude since intrinsic magnetometer noise would in principle permit a sensitivity of approximately 10^{-15} cgs. By using a known source of flux in the form of a long solenoidal coil, an independent calibration of the system has been achieved in agreement with a secondary calibration using a paramagnetic salt. A number of measurements including nuclear magnetic resonance, static susceptibility and susceptibility as a function of temperature have been demonstrated with the system. By making static susceptibility measurements the particular problem of the origin of the anomaly in the susceptibility of Tris(pyrrolidyldithiocarbamato) iron (III) has been shown to be caused by antiferromagnetic interactions. Improvements to the prototype system and some new design features are discussed in connection with a number of new experiments. (Diss. Abstr. Int., B)

22523 SUPERCONDUCTIVE NIOBIUM RESONATORS WITH GALVANIC COATING. Litvinov, V. N. Tr. Radiotekh. Inst.; No. 15, 164-172; 186(1973). (In Russian).

Methods of manufacture and results of testing superconductive niobium resonators produced by electrolysis of niobium from a melt of fluoride salts are presented. Cavity resonators were studied at a frequency of 9192 MHz, and coaxial resonators at a frequency of 820 MHz. (Referativnyi Zh.)

22524 INVESTIGATION OF NIOBIUM RESONATORS AT 4.2-1.5°K. Vladimirov, V. V.; Saverin, V. N.; Shchelokov, V. A. Tr. Radiotekh. Inst.; No. 15, 156-163; 186(1973). (In Russian).

A procedure is described for testing stamped niobium resonators welded by electron beams. The surface resistance of the resonators was checked on wavemode E_{010}. A discrepancy between the experimental and theoretical temperature dependence of surface resistance can be attributed to appreciable residual losses of rf power in the superconducting surface of the resonator. (Referativnyi Zh.)

22525 EXPERIMENTAL STUDY OF THE SPE-600 SUPERCONDUCTIVE ELECTROMAGNET. Vodop'yanov, F. A.; Gridin, O. M.; Dotsenko, S. R.; Karbanov, V. N.; Konovalov, V. V.; Litvinov, V. N.; Saverin, V. N. Tr. Radiotekh. Inst.; No. 15, 76-85; 182-183(1973). (In Russian).

The results of experimental studies of the SPE-600 superconductive electromagnet are presented. A field of ~30,000 G (~3 T) was achieved at a current of ~2500 A. The energy accumulated by the magnet amounts to 4 MJ. Bringing the magnet to the superconductive state takes ≤1000 liters of helium. The heat flux in the cryostat in the absence of current in the winding is ≤5 W. (Referativnyi Zh.)

22526 METHOD OF PRODUCING A COMPOSITE SUPERCONDUCTOR. Tachikawa, K.; Yoshida, Y. (to Director of National Research Inst. for Metals). US Patent 3,857,173. 31 Dec 1974. Priority date 9 Feb 1970, Japan. 10p.

A superconductor including V_3Ga or V_3Si is produced by making a composite of a vanadium core metal and a copper, silver or copper-silver alloy containing gallium or silicon, fabricating the composite to a desirable shape, followed by heat treatment. The

vanadium core may contain titanium, zirconium or hafnium. (Official Gazette)

22527 DEVELOPMENT OF A 5 MVA SUPERCONDUCTING GENERATOR: TESTING AND EVALUATION. Chang, Y. W.; Jones, C. K.; Karpathy, S.; Litz, D. C.; Patterson, A.; Walker, M. S. (Westinghouse Electric Corp., Pittsburgh). IEEE Trans. Power App. Syst.; PAS-93: No. 2, 496-499(1974).

A 5 MVA superconducting generator has been tested and the design performance has been achieved. The test results demonstrate the feasibility of applying superconducting electrical machinery to central station power plants and to ship propulsion systems. The testing and operation of a superconducting generator required a test facility with a number of features which are not normally found in a test facility for conventional electrical rotating machinery. The instrumentation and control systems are described, and the methods of operation and testing are discussed. The results of these tests and their significance are discussed. (auth)

22528 DOES THE "TWO-LEVEL-ATOM" PICTURE OF A JOSEPHSON JUNCTION HAVE A THEORETICAL FOUNDATION IN BCS? Rogovin, D.; Scully, M.O. (Department of Physics and Optical Sciences Center, University of Arizona, Tucson, Arizona 85721). Ann. Phys. (N.Y.) 88: No. 2, 371-396 (Dec 1974).

Yes, except that the rigorous equations are nonlocal and involve the internal pair coordinates. (auth)

22529 PARAMETRIC EXCITATION OF PLASMA OSCILLATIONS IN A JOSEPHSON TUNNEL JUNCTION. Bak, C.K.; Kofoed, B.; Pedersen, N.F.; Saermark, K. (Physics Laboratory I, Technical University of Denmark, DK-2800 Lyngby, Denmark). J. Appl. Phys. 46: No. 2, 886-889 (Feb 1975).

Experimental evidence for subharmonic parametric excitation of plasma oscillations in Josephson tunnel junctions is presented. The experiments described are performed by measuring the microwave power necessary to switch a Josephson-tunnel junction biased in the zero-voltage state to a finite-voltage state. (auth)

22530 SMALL-SIGNAL ANALYSIS OF THE GAIN AND NOISE PERFORMANCE OF THE JOSEPHSON MIXER. Habib, S.E.E.; Dmitrevsky, S. (Electrical Engineering Department, University of Toronto, Canada M5S 1A4). J. Appl. Phys. 46: No. 2, 900-907 (Feb 1975).

The behavior of the voltage-biased Josephson junction coupled to a general external circuit is studied in the small-signal limit. The Josephson relations are formulated in the frequency domain in the form of an infinite set of difference equations relating the current and voltage amplitudes of different frequency components. The results are subsequently utilized to develop a general theory of the self-oscillating Josephson mixer, including noise. The noise temperature and conversion gain of the mixer are derived taking into consideration the image frequency response. A comparison is made between the operation of the negative-resistance converter in the SC regime and its operation in the OC regime. (auth)

22531 SUPERCONDUCTING dc TRANSFORMER COUPLING. Sherrill, M.D.; Lindstrom, W.A. (Department of Physics and Astronomy, Clemson University, Clemson, South Carolina 29631). Phys. Rev. B 11: No. 3, 1125-1130 (1 Feb 1975).

Measurements of the ratio of secondary voltage to primary voltage as a function of the secondary current allow a determination of the superconducting dc transformer coupling force. The force was measured for tin-film transformers. The primary film thickness and the thickness of the SiO insulating layer were varied. The maximum coupling force appears to be given approximately by $F_{cm} \simeq (\phi_0^2/8\pi\mu_0)\,[\lambda_p \coth(d_p/\lambda_p) + \xi_p + d_0]^{-1} \times [\lambda_s \coth(d_s/\lambda_s) + \xi_s + d_0]^{-1}$. Here d_0, d_p, and d_s are the oxide thickness, primary thickness, and secondary thickness, and other symbols are standard. (auth)

22532 SUPERCONDUCTING CABLE COMMUNICATION LINES. Grodnev, I. I.; Levinov, K. G.; Gal'perovich, D. Ya. Elektrosvyaz; No. 2, 1-7(1974). (In Russian).

Superconductors and dielectrics at cryogenic temperatures are discussed, and it is pointed out that as early as 1948 the use of the phenomenon of superconductivity was proposed for creation of coaxial communication cables. The structural and electric characteristics of microcoaxial superconducting cables and the construction of cryogenic sheathing are presented. The results of a calculation of the parameters of one superconducting cable are given in table form, and a figure is shown of one possible construction of a superconductivity cable and a cryogenic sheathing. It is reported that one of the means of creating superconducting main lines of communication is to arrange a communication cable in a joint cryogenic pipeline constructed for the transmission of energy. Such combined superconducting cables for power purposes and communication cables under a common cryogenic sheathing is very promising and advantageous in technical-economical respects. (JPRS)

Heat Transfer and Fluid Flow

Refer also to abstracts 24649, 24736, 24923, 24987, and 24995.

22533 (AAEC/E-323) BURNOUT DATA FROM ANNULI COOLED BY UPFLOW OF FREON-12. Ilic, V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1974. 51p. Dep. NTIS (US Sales Only) $5.75.

Burnout and pressure drop data are presented for a series of 29 annuli cooled by upflow of Freon-12 at an inlet pressure of 1.04 MPa with internal, external and combined internal and external heating. The test sections had a uniform axial heat flux distribution, except for one internally heated test section which had a chopped cosine axial heat flux profile (form factor = 1.4). The test sections covered a range of annulus geometries; heated lengths range from 457 mm to 4,277 mm; hydraulic and internal tube diameter ranges are 1.55 mm to 8 mm and 8 mm to 19 mm respectively. The mass velocity range is 0.7 to 4 Mg $m^{-2}s^{-1}$, and inlet subcooling values range up to 26 kJ kg^{-1}. (auth)

22534 (AAEC/E-325) EFFECT OF PRESSURE ON BURNOUT IN A ROUND TUBE COOLED BY FREON-12. Ilic, V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

A resistance heated, uniform wall thickness, stainless steel tube (16 mm id × 2,860 mm long) with an upflow of Freon-12 (dichlorodifluoromethane), subcooled at the inlet, was used to obtain data of the effect of pressure on burnout heat flux. Values of reduced pressure (ratio of system pressure to the critical pressure of the fluid) at inlet to the test section were in the range from 0.2 to 0.4, with mass velocity ranging 0.8 to 4.1 Mg $m^{-2}s^{-1}$. Data are adequately described by an existing correlation, except at the lowest test pressure (reduced pressure of 0.215) where the experimental values of burnout heat flux were up to 40% higher. (auth)

22535 (AD-787640) USE OF WATER COOLING FOR PROTECTION AGAINST THERMAL RADIATION FROM A NUCLEAR WEAPON DETONATION. Wilson, D. M.; Katz, B. S.; Demske, D. (Naval Ordnance Lab., White Oak, Md. (USA)). 23 Apr 1974. 106p. (NOLTR-74-59). NTIS $5.25.

A continuing study to find methods of protecting shipboard elements from the combined thermal radiation and airblast effects of a nuclear weapon explosion is discussed. Data from heat transfer experiments to measure the heat transfer rates of a water flow or spray on a heated plate are presented. These data were used to predict the effectiveness of water cooling the exposed aluminum plating on ships which are subjected to a nuclear weapon detonation. (GRA)

22536 (ANL-CT-75-05) FLOWS IN HEAT EXCHANGER PLENUMS. Burton, R.; Kistler, A.; Groth, C.; Rohde, R. R.; Domanus, H. M. (Aerolab Development Co., Pasadena, Calif. (USA)). Jan 1975. 84p. AT.

Approaches taken to analyze flows in heat exchanger plenums are indicated, and computer programs to aid in solving flow distribution problems in real heat exchangers are developed. (LCL)

22537 (ANSP-M-10) SURVEY OF POSSIBLE NODE DROPPING TECHNIQUES FOR USE IN THE STANDARD HEAT TRANSFER PROGRAM. Randall, J. D. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Jul 1974. 117p. (AEC/SNS-3060-010). Dep. NTIS $9.00.

Comparisons of several implicit and explicit node dropping schemes, including five front node dropping schemes and one interior node dropping scheme, for possible incorporation into APL's Standard Heat Transfer Program are presented. Numerical solutions are compared to exact solutions for each of the six methods for a receding semi-infinite solid subject to convective heating on the receding surface. All thermal properties, the surface conductance, the ambient temperature, and the recession velocity are assumed to be constant; however, these assumptions are not necessary to implement the methods studied. (auth)

22538 (ORNL-TM-4607) SYSTEMS DESIGN DESCRIPTION OF THE THERMAL TRANSIENT TEST FACILITY (TTTF). Young, H. C.; Grindell, A. G. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 194p. Dep. NTIS $7.60.

The Thermal Transient Test Facility (TTTF) is a high-temperature, high-pressure sodium test facility designed to subject test specimens to internal pressure and intermittent thermal downshocks to produce thermal ratchetting. The facility was built as a part of the ORNL High-Temperature Structural Design Methods for Liquid-Metal Fast Breeder Reactor (LMFBR) Components

(189a No. 10556) program. The purpose of the program is to develop a verified design technology, including methods and criteria, applicable to the high-temperature, long-term operating conditions expected for LMFBR vessels, components, and core structures. In the TTTF, a test specimen is filled with static sodium at pressures to 700 psig and at temperatures to 1100°F and subjected to a thermal downshock at temperature rates to 30°F/sec by forcing colder temperature-graded sodium through the test section while maintaining the test section at pressure. The high-pressure portion of the system contains approximately 250 gal of sodium; when the system is drained, the low-pressure sump tank contains approximately 750 gal of sodium. Strain rates are measured on the test section by high-temperature capacitance-type strain gages. A fast-scan data-acquisition system is used to record pertinent test measurements on magnetic tape for computer processing. The facility is equipped with automatic control and alarm equipment to permit unattended operation. The various systems that make up the TTTF, i.e., the sodium system, the high- and low-pressure argon systems, the sodium purification system, the test section, the electrical system, and the instrumentation and control systems, are described. (auth)

22539 (TID/SNA-164) HEAT-TRANSFER STUDIES. Core, T. C.; Harkee, J. F.; Misra, B.; Sato, K. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1959. 50p. Dep. NTIS $5.50.

Heat transfer to hydrogen in the regions of forced convection in the liquid and gaseous phases, nucleate boiling, and stable film boiling was investigated with a blow-down type apparatus utilizing an electrically heated stainless-steel tubular test section through the following range of conditions: velocity—25 to 55 ft/sec; inlet bulk temperature—40 to 57°R; outlet bulk temperature—40 to 147°R; inlet pressure—28 to 213 psia; heat flux—0.01 to 6.0 Btu/in.^{2} sec; and wall temperatures—51 to 1505°R. All experiments were terminated prior to tube burnout. Based on the experimental heat-flux data on hydrogen under conditions of stable film boiling and forced convection in the gaseous phase, the heat-transfer analysis in a low-pressure thrust chamber was carried out. The results indicate the feasibility of employing hydrogen as a regenerative coolant. (auth)

22540 ANALYSIS OF ONE-DIMENSIONAL PRESSURE PULSE PROPAGATION IN A CLOSED FLUID SYSTEM. Chen, W. L.; Shin, Y. W.; Thompson, D. H. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 57-65(Nov 1974).

This paper describes a unique numerical method for linear inviscid fluid hammer analysis based on the method of characteristics. The uniqueness lies in that it uses the analytical solutions of the wave equation in place of the compatibility relations of the more conventional method of characteristics. The numerical solution is obtained by a simple superposition technique for tracing the waves traveling along each characteristic and extending the solution from one constant time line to the next. Using a predetermined finite difference net of grids with equal spacings, an elimination is made of the spatial interpolation, thereby maintaining the wave amplitudes in their full strength in the numerical procedure. This is in contrast to the case of a nonlinear problem in which the pressure peaks are always flattened to some degree in the interpolation procedure. The computer program NAHAMMER is a system analysis code adequate for short-term pressure transients of most engineering problems of significance involving a moderate pressure source. It considers the simplified one-dimensional, linear inviscid set of governing equations with an isentropic flow assumption. A closed fluid-network system is considered to be composed of a multiple of one-dimensional pipe sections and components that are connected by various joints. An analytical solution is obtained under an acoustic approximation for a simple system and the result shows good agreement with the numerical solution. As examples of the application of the method, complex problems of engineering importance are calculated and the results are presented. (auth)

22541 TEMPERATURE DISTRIBUTIONS IN LIQUID METALS FOR TURBULENT FLOW IN A HORIZONTAL PIPE WITH FREE CONVECTION. Buhr, H. O.; Sesonske, A. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Nuclear Engineering). Nucl. Eng. Des.; 31: No. 1, 46-56(Nov 1974).

A general method is developed for utilizing limited experimental data to obtain velocity or temperature distributions over the cross-section of a heated horizontal pipe, under conditions where distortion occurs due to superimposed free convection effects. The method is applied to available temperature data for five cases of constant-flux heating of liquid metals in turbulent flow, and the resulting isotherms and wall temperature distributions are presented. Substantial asymmetry is demonstrated for Reynolds numbers as high as 10^5, with a corresponding distortion of the wall temperature distribution, and it is found that local heat transfer coefficients may be as low as 30% of predicted values. (auth)

22542 HANGING FILM PHENOMENON IN VERTICAL ANNULAR TWO-PHASE FLOW. Wallis, G. B.; Makkenchery, S. (Dartmouth Coll., Hanover, NH). J. Fluids Eng.; 96: No. 3, 297-298(Sep 1974).

Under certain conditions it is possible to support a liquid film, with zero net flow rate, on the inside wall of a vertical tube by flowing gas upwards through the tube. At low gas velocities the film runs down the tube, while at high gas velocities it is blown up and out of the tube. The "hanging film" condition occurs at intermediate velocities and represents a boundary between co-current and countercurrent flow of the phases. There are several practical applications which involve this effect. For example, if gas is blown through a pipeline with vertical branches which initially contain liquid, the hydrostatic pressure drop may be significant. If this liquid can be blown out, by exceeding some critical gas flow rate for a while, the pipe will become dry and the pressure drop will be lower even after the gas flow rate is reduced. Another example of current interest is the problem of penetration of water from above into a hot nuclear reactor following a postulated accident. It is important to know if the flow of steam upwards out of the core, due to boiling of water which has already penetrated, will be sufficient to prevent further water from entering. Depending on the details of the experiment this phenomenon may occur at a particular gas velocity or over a range of gas velocities. (auth)

22543 INCIPIENT SODIUM BOILING IN A ROUND TUBE. Buleev, N. I.; Kazakova, L. Ya.; Loshchinin, V. M.; Palkin, I. I.; Proslov, P. B. Inzh.-Fiz. Zh.; 27: No. 6, 957-963(Dec 1974). (In Russian).

The calculation results for a monobubble boiling model for sodium in a tube are given. The effect of superheat, specific heat flux and nucleation site on the process development is considered. (auth)

22544 APPLICATION OF THE REYNOLDS FLUX MODEL OF CRITICAL HEAT FLUX FOR DIRECT HEAT FLUX SCALING IN NONUNIFORM ROD BUNDLES. Purcupile, J. C. (Carnegie-Mellon Univ., Pittsburgh); Motley, F. E.; Cadek, F. F. J. Heat Transfer; 97: No. 1, 144-145(Feb 1975).

A method of scaling critical heat flux (CHF), based on the Reynolds flux model, was used to predict the CHF in rod bundles with nonuniform heat flux. (LCL)

22545 NUCLEATION SITE ACTIVATION IN SATURATED BOILING. Shoukri, M.; Judd, R. L. (McMaster Univ., Ont.). J. Heat Transfer; 97: No. 1, 93-98(Feb 1975).

An experimental investigation is presented for the boiling of distilled degassed water at atmospheric pressure on a single copper surface with different surface finishes, in which the activation of nucleation cavities under the influence of different levels of heat flux was investigated. The measured active cavity radii showed good agreement with the active cavity radii predicted by the Hsu model. As a result of this investigation, it would appear that smaller cavities are better able to entrap vapor residue and be activated by their neighbors when boiling is initiated on the surface than larger cavities and that the reason for the relatively high levels of superheat at incipience commonly encountered is the nonexistence of sufficiently large cavities with the prerequisite residue of vapor. The correlation suggested by Brown relating the active site density $(N/A)_{r_c}$ as a function of cavity radius r_c in the form $(N/A)_{r_c} \alpha (1/r_c)^m$ was confirmed. On the basis of this work Griffith and Wallis' recommendation that the parameter group $[2\sigma T_s/\rho_v h_{fg} (T_w - T_s)]$ be used to characterize a boiling surface was substantiated. (auth)

22546 INVESTIGATION OF TEMPERATURE FIELDS IN THE FLOW OF A SODIUM—POTASSIUM MELT IN THE CELL OF A COMPACT ROD BUNDLE. Kolyaskin, V.I.; Kudryavtseva, L.K.; Ushakov, P.A. High Temp. 12: No. 3, 480-484 (Jan 1975).

The article describes a method for investigating temperature fields in the flow of a sodium—potassium melt. It gives temperature profiles along normals to the perimeter of the cell and compares these profiles with an empirical formula proposed by P. L. Kirillov [5] for the temperature profile of liquid metals in round tubes. It is shown that, for approximate calculations of temperature fields in bundles of rod—type fuel elements, use can be made of the hypothesis of the universality of the temperature profiles in the cells of bundles and in round tubes. (auth)

22547 THEORETICAL INVESTIGATION OF FLOW IN A NOZZLE WITH A TWO—PHASE WORKING BODY. Lepeshinskii, I.A. (Moscow Aviation Institute). High Temp. 12: No. 3, 497-502 (Jan 1975).

In a quasi-one-dimensional approximation, for a one-component working body of the type liquid potassium-potassium vapors, we discuss flow in a nozzle for a two-velocity, two-temperature model with phase transitions. We investigate the effect of shaping the channel of the nozzle and of the boundary conditions on the efficieny of the nozzle. (auth)

22548 STATISTICAL CHARACTERISTICS OF TEMPERATURE FLUCTUATIONS IN A TURBULENT FLOW OF MERCURY. Genin, L.G.; Krasnoshchekova, T.E.; Manchkha, S.P.; Sviridov, V.G. (Moscow Power Institute). High Temp. 12: No. 3, 473-479 (Jan 1975).

The results of measurements of the intensities, correlation coefficients, and spectra of temperature fluctuations are described. The measurements were carried out in a mercury flow in a vertical circular pipe in the range of Reynolds numbers $Re = 7 \cdot 10^3$ to $50 \cdot 10^3$ and of heat fluxes $q_w = (1 \text{ to } 2.5) \cdot 10^4$ W/m^2. The results are presented as a function of the Re number, the dimensionless radius R, and the longitudinal coordinate. They are compared with the data of other authors. The measurement procedure is described and the reliability of the results estimated. (auth)

22549 TECHNIQUES OF CALCULATING CRITICAL HEAT FLUXES IN BUNDLES OF UNIFORMLY HEATED RODS. Glushchenko, L. F.; Mayevskii, E. M.; Eremenko, V. K. (Kiev Polytechnic Inst.). Heat Transfer-Sov. Res.; 6: No. 6, 144-147(1974).

Translated from Teplofiz. Teplotekh.; 23: 116-119(1973).

Upon analysis of published data on heat transfer crisis in longitudinal rod bundles, a technique is suggested for calculating critical heat fluxes in multirod heat-generating assemblies. The design equation is in satisfactory agreement with experimental data. (auth)

22550 EFFECT OF THE RELATIVE DEPTH OF THE INTERFIN SPACE ON HEAT TRANSFER FROM BUNDLES OF FINNED TUBES. Kuntish, V. B.; Taryan, I. G.; Yokhvedov, F. M. Heat Transfer - Sov. Res.; 6: No. 6, 5-9(1974).

Translated from Izv. Vyssh. Ucheb. Zaved., Energ.; 11: 136-143(1973).

A quantitative relationship is established between the rate of heat transfer from staggered bundles of tubes with transverse circular fins and the relative depth of the interfin space of the tube. The fins which are sliced along their generatrix attain independence of the coefficient of heat transfer from the slit fin from the interfin space depth. Dimensionless equations are presented for calculating transfer of heat from smooth and slit fins. (auth)

Materials Testing

Refer also to abstracts 22689 and 22832.

22551 (IEA-348) SENSITIVITY OF IMAGE QUALITY INDICATORS FOR WIRES USED IN RADIOGRAPHIC EXAMINATIONS OF METALS AND ALLOYS. Sanchez, W.; Oki, H. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jun 1974. 26p. (In Portuguese). Dep. NTIS (US Sales Only) $4.25.

Radiographic sensitivity is defined and its mathematical expression is derived in order to justify the use of image quality indicators (IQI) formed by wires of different diameters which represent the radiographic quality. It is demonstrated that the IQI sensibility is not related to the minimum dimensions of the metallic discontinuities that may be detected in radiographic tests. The experimental results are in good agreement with the mathematical formulation proposed. The radiographic quality of the finished radiograph must be analyzed as function of the IQI visibility. For the same image quality, the existence of different sensibilities based on different IQI'S, is demonstrated. It is easier to visualize a stepped IQI image than a wire image of the same diameter. On the other hand, the image of a wire is more visible than that of a circular hole of the same diameter and depth, because the visibility depends on both diameter and depth. The IQI cannot guarantee the detection of discontinuities with the same dimensions as those of the test sensibility obtained. The detection of a discontinuity depends on its dimensions and on its orientation, relative to the bundle of incident radiation. The percent sensibility of thickness is a relative value which depends on the sample thickness. On the other hand, the "image quality index", characterized by the order number of the IQI wire is an absolute value. Some illustrative examples are included. (auth)

22552 (LA-3824) EDDY-CURRENT DETECTION OF CRACKING DURING THERMAL TRANSIENTS. Edenborough, N. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 16 Jan 1968. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

Declassified 3 Mar 1975.

An eddy-current system for detection of cracking of Phoebus Reactor pedestals during thermal transients at about 1700°R is described. The pedestal is a support member positioned near the exit (hot) end of the reactor. The pedestal consists of a graphite-niobium composite. (TFD)

22553 (UCRL-76135) CENTRAL COMPUTER ANALYSIS OF MICROCOMPUTER ACQUIRED DATA FOR ACOUSTIC EMISSION FLAW DETECTION IN SOLID BODIES. Tatro, C. A.; Dickinson, R. P.; Freeman, T. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 11p. (CONF-741001-53). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A method of on-line safety assurance monitoring for the LLL 345 MPa autoclave has been developed. It utilizes a multisensor acoustic emission based flaw detection system with minicomputer aided data acquisition capability. While this system is capable of revealing repeatedly incrementing flaws, it is incapable of calculating flaw location accurately in the virtually solid end caps of this device. To achieve flaw location, a three dimensional flaw location theory was developed. The minicomputer acquired data was transferred to a CDC 7600 computer, where flaw location calculations were performed and graphical displays of results were made. A viable method of achieving shut down of this device to prevent an approaching catastrophic failure is demonstrated. (auth)

22554 NON-DESTRUCTIVE MATERIAL TESTING. Reti, P. 1974. (ISBN-377760254X). 262p. (In German). INIS.

Transl. from Hungarian, published by Akademiai Kiado, Budapest.

In this book the best known modern non-destructive testing methods are dealt with: (1) radiography, (2) ultrasonics, (3) magnetic and electrical tests and (4) chemical failure detection. Apart from the physical bases of the method, methodics apparative equipment and practical fields of application are described in detail. (GE)

22555 NDT METHODS AND APPLICATIONS. Hordern, M. Test., Instrum. Contr.; 11: No. 6, 13-21(Jun 1974).

A discussion is given of nondestructive tests as they apply to weld examination and information is provided on which to base the selection of the most appropriate test method for a particular need. The nondestructive tests which are discussed include: x-ray radiography; gamma radiography; ultrasonic testing; eddy current testing; magnetic testing; and liquid penetrant inspection. (AT)

Nuclear Explosions

Refer also to abstracts 22535, 22624, 22820, 22821, and 22831.

22556 (AD-768958) MECHANICAL PROPERTIES OF NEVADA TEST SITE TUFFS FROM SELECTED EXPLORATORY DRILL HOLES. Final Report. Butters, S. W.; Reid, R. J.; Green, S. J.; Jones, A. H. (Terra Tek, Inc., Salt Lake City, Utah (USA)). 21 Sep 1973. Contract DNA001-73-C-0017. vp. (TR-73-28DNA-3181F). NTIS $3.75.

Cores taken from selected exploratory holes at the Nevada Test Site were tested to determine the suitability of the location for a nuclear experiment. Tuff specimens were loaded/unloaded hydrostatically to four kilobars pressure. Additionally, both constant confining pressure and uniaxial strain tests were conducted. This report consolidates all the data previously reported separately for the different sites. (auth)

22557 (AD-780037) MECHANICAL PROPERTIES OF TWO HIGHLY POROUS GEOLOGIC MATERIALS. Final Report, April 1972-April 1973. Shipman, F. H.; Johnson, J. N.; Green, S. J. (Terra Tek, Inc., Salt Lake City, Utah (USA)). Apr 1974. Contract DAAG46-72-C-0169. 65p. (AMMRC-CTR-74-25). NTIS $3.75.

Hydrostatic pressure, compression under different confining pressures, proportional loading and uniaxial-strain tests were conducted on a dry tuff from the Nevada test site and dry kayenta sandstone from the mixed company site near Grand Junction, Colorado. Both rocks exhibit behavior which is characteristic of very porous geological materials; namely, increasing shear strength as a function of confining pressure, large volume compaction followed by volume dilatancy under selected loading with enhanced compaction, over some pressure ranges, in the presence of shear deformation. Both materials also exhibit strain work-hardening. A cap model is applied to represent the mechanical behavior of these two materials. This model accounts for all of the aforementioned characteristics of both the tuff and the sand-

stone, and provides a means to represent the path dependence of their mechanical properties. (auth)

22558 (AD-780193) MULTIBURST STUDY. Final Report, 26 December 1972–31 October 1973. Mantrom, D. D. (TRW Systems Group, Redondo Beach, Calif. (USA)). 31 Dec 1973. Contract DNA001-73-C-0085. 48p. (DNA-3267F). NTIS $3.25.

An experimental program to study shock/fireball interactions is described. Preliminary experiments led to the hypothesis that it is the magnitude of shock-induced circulation within the fireball relative to self-generated circulation which governs the post-shock fireball motion. A scaling of sorts relating the full scale scenarios to the laboratory tests is discussed based upon this circulation argument. Experiments were performed using an open-ended shock tube as the shock generator and helium bubbles in a ten atmosphere air environment as the simulated fireballs. (auth)

22559 (AD-780199) GROUND MOTION CALCULATIONS FOR EVENTS II AND III OF THE MIDDLE GUST SERIES. Topical Report, 30 Jan 1973–31 Jan 1974. Sandler, I. S.; Wright, J. P.; Baron, M. L. (Weidlinger Associates, New York (USA)). 5 Apr 1974. Contracts DNA001-72-C-003; DNA001-73-C-0023. 150p. (DNA-3290T). NTIS $4.75.

Results are presented from ground motion calculations of events II and III of the Middle Gust test series. The calculations were performed using large and small strain versions of the LAYER code in which the material behavior of the ground was described and fit by means of a CAP model and the surface loading was fit to a calculation of Needham. The results of the computations are compared to gauge records obtained in the field events. The calculated crater dimensions and peak airblast-induced motions, particularly in the vertical direction, are in reasonable agreement with the field data, while other features of the motion, particularly waveforms, are not as well represented in the calculations. The reasons for the discrepancies are discussed and some points of interest for future study are indicated. (auth)

22560 (AD-780939) ELECTROMAGNETIC PULSE ENVIRONMENT STUDIES. Final Report. Knight, R. L.; Parkinson, E. R.; Pine, V. W. (Science Applications, Inc., Albuquerque, N. Mex. (USA)). 28 May 1974. Contract DAAG39-73-C-0131. 115p. (SAI-74-502). NTIS $4.50.

A number of investigations related to the development of a near-surface EMP code were carried out. Important considerations in the development of a near-surface burst EMP code include the choice of coordinate system, the form of the electromagnetic field equations that is chosen for solution, the differencing scheme used to represent the field equations, and the choice of boundary conditions applied to the problem to be solved. Such considerations are also affected by requirements that the conductivity and dielectric constant have spatial structure, and that far-field predictions also be provided, either directly or by extrapolation techniques. (auth)

22561 (AD-781316) PRETEST GROUND MOTION CALCULATIONS FOR THE MIXED COMPANY EVENT OF THE MIDDLE NORTH SERIES. Data Report. Sandler, I. S.; Wright, J. P.; Baron, M. L. (Weidlinger Associates, New York (USA)). Oct 1972. 159p. NTIS $11.00.

The report presents results from a set of pretest calculations for the Mixed Company Event of the Middle North test series. The planned test configuration consists of a 500 ton sphere of TNT tangent to the ground surface. The site geology is characterized by a layer of clayey silt, varying from 1 to 8 ft in thickness, over an interfingering sequence of sandstones containing clay inclusions. The objective of these calculations was to obtain pretest ground motion predictions at points corresponding to in situ gage locations extending from ground zero out to ranges of approximately 1400 ft. (GRA)

22562 (AD-783605) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 11, Evaluation of the Norwegian Short-Period Array. Final Summary Report, 1 April–30 September 1973. Ringdal, F.; Whitelaw, R. L. (Texas Instruments, Inc., Dallas (USA)). 2 Nov 1973. Contract F33657-72-C-0725. 95p. NTIS $3.25.

The final phase of the evaluation of the Norwegian short-period seismic array (NORSAR) which has been conducted by Texas Instruments Incorporated at the seismic data analysis center is described. The report also summarizes results achieved during the complete evaluation study over the period 1 April 1971 to 30 Sep. 1973. The major areas of study covered by this report are: array processing performance; partial array performance; maximum likelihood estimation of the NORSAR event detection capability; and evaluation of short-period discriminants. The accumulated data base for this study has been 547 events, including 39 presumed explosions, 33 of which are from the Eurasian continent. (auth)

22563 (AD-783606) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 13, Evaluation of the Discrimination Capability of the Norwegian Seismic Array. Ringdal, F. (Texas Instruments, Inc., Dallas (USA)). 23 Nov 1973. Contract F33657-72-C-0725. 80p. NTIS $4.00.

Results from an evaluation of the discrimination capability of the Norwegian short and long period array (NORSAR) for Eurasian events are presented. The following types of discriminants have been analyzed and their performance has been compared: Rayleigh wave energy versus $M_b(M_s - M_b, Ar/M_b)$; Love wave energy versus $M_b(M_s - M_b, Al/M_b)$; short period P-wave complexity versus M_b (three discriminants); and short period P-wave spectral content versus M_b (dominant period, spectral ratios). The total data base for this evaluation consists of 233 earthquakes from 1971 to 1972 and 24 presumed explosions from 1971 to 1973. (auth)

22564 (AD-783646) VELA NETWORK EVALUATION AND AUTOMATIC PROCESSING RESEARCH. Quarterly Report No. 1, 1 November 1973–31 January 1974. Hartley, T. W. (Texas Instruments, Inc., Dallas (USA)). 15 Sep 1974. Contract F08604-74-C-0033. 14p. NTIS $3.00.

This first quarterly report summarizes progress under the Vela network and automatic processing research program during the period Nov. 1, 1973 to Jan. 31, 1974. Work in the following areas is summarized: VLPE station evaluation; network analysis, signal detection; signal estimation; and, first zone discrimination. (GRA)

22565 (AD-783717) DEVELOPMENT OF ELECTRIC FIELD SENSORS. Final Report, 1 June 1972–15 September 1973. Taylor, W. C.; Whitson, A. L.; Gates, D. C. (Stanford Research Inst., Menlo Park, Calif. (USA)). 26 Feb 1974. Contract DNA001-72-C-0102. 77p. (DNA-3259F). NTIS $4.00.

The purpose of this program was to obtain parametric data and develop criteria needed in the design of wire-mesh-type electric-potential sensors for arbitrary electromagnetic pulse (EMP) and internal electromagnetic pulse (IEMP) environments. Tests were performed with various grid materials, thicknesses, and configurations in selected environments provided by the Febetron 706, Febetron 705, and Aurora flash gamma-ray machines, with varied environmental parameters such as air pressure and cavity material. It is shown that this technique can be used successfully when an essentially open-circuit voltage measurement is made, provided that care is taken to prevent large amounts of charge from being deposited on or scattered from the grid, which causes it to depart from the space-charge potential it is intended to measure. The various sources of these charges are described, and methods of minimizing the problem are demonstrated. Furthermore, a method is illustrated that allows discrimination between the desired space-charge potential and the error-producing charge-deposition potential. (auth)

22566 (AD-784837) LONG-PERIOD SEISMOLOGICAL RESEARCH PROGRAM. Annual Report, 15 March 1971–30 April 1974. Sykes, L. R.; Savino, J. M. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). 14 Jun 1974. Contract F44620-71-C-0082. 24p. (AFOSR-TR-74-1333). NTIS $3.00.

A technique for studying the focal mechanisms of small magnitude events at teleseismic distances was developed. By comparing observed amplitudes of long-period Rayleigh and Love waves with radiation patterns of focal mechanisms consistent with the previously determined tectonic regime of a certain region, it is possible to discriminate between different types of mechanisms on the basis of signals received at a very limited number of stations. The detection capabilities of the VLP station were evaluated using the special listing of events during the International Seismic Month. Surface waves were observed for 90% of the reported events of (M_b) 4.6 or greater. Half of the unobserved events were due to masking by the coda of earlier larger events. For 10% of the events observed at deep stations, only Love waves were observed. (auth)

22567 (AD-784898) DETERMINATION OF SEISMIC SOURCE PARAMETERS FROM LONG-PERIOD TELESEISMIC WAVES. Semiannual Technical Report No. 2 (Part A), 1 November 1973–31 May 1974. Turnbull, L. S.; Sun, D.; Black, D. G. (Texas Instruments, Inc., Dallas (USA)). 31 May 1974. Contract F44620-73-C-0055. 109p. NTIS $4.50.

Spectral-fitting procedures are applied to teleseismic surface wave data for determining seismic source parameters, especially depth. From an examination of theoretical Rayleigh and Love wave spectra as a function of source structure, significant

variation of the spectra can result from differences of gross tectonic structure in most cases. For very shallow events (less than 5 km), though, the effect of source structure is minimal. Seven Eurasian events are analyzed for source mechanisms. For those with known depth from bodywave phases, knowledge of the source region crustal structure is crucial to obtain focal depth agreement from spectral fitting. These source structures were then applied to events in the same region with no independent depth estimate. (GRA)

22568 (AD-784899) VELA NETWORK EVALUATION AND AUTOMATIC PROCESSING RESEARCH. Quarterly Report No. 2, 1 February–30 April, 1974. Harley, T. W. (Texas Instruments, Inc., Dallas (USA)). 15 May 1974. F08606-74-C-003. 15p. NTIS $3.00.

The following topics are discussed: VLPE station evaluation; signal detection techniques; signal estimation techniques; first zone discrimination; and system study. (GRA)

22569 (AD-784909) MULTIPLE SEISMIC EVENTS. Semi-annual Technical Report No. 2, 1 January–31 May 1974. Taylor, R. W.; Willis, D. E. (Wisconsin Univ., Milwaukee (USA). Dept. of Geological Sciences). 15 Jul 1974. 55p. (AFOSR-TR-74-1346). NTIS $3.75.

An investigation of multiple seismic events and first zone discriminants is described. Spectral analyses were made for several nuclear shots and an earthquake that had the same general transmission paths between source region and recording stations. The results of these studies showed that the mean slope of the nuclear event spectra in the frequency range from 1.0 to 0.135 Hz is negative, while the mean slope for the earthquake over the same frequency range is zero. Cross-correlation studies were initiated between different nuclear shots recorded at the same stations and between an earthquake and nuclear shots for the same stations. The study of secondary arrivals by use of spectrum analyses was continued during this report period. (GRA)

22570 (AD-784940) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 12. Continued Evaluation of the Norwegian Long-Period Seismic Array. Final Report. Laun, P. R.; Shen, W. W.; Swindell, W. H. (Texas Instruments, Inc., Dallas (USA)). 3 Dec 1973. Contract F33657-72-C-0725. 134p. NTIS $4.75.

The final results of the continued evaluation of the Norwegian long-period seismic array (NORSAR) by Texas Instruments Incorporated at the Seismic Data Analysis Center over the period 1 April 1973 to 30 September 1973 are presented. The major areas of study were: noise analysis; array processing performance; effectiveness of matched filters; surface wave detection capability; and, performance of standard surface wave discriminants. A total of 133 Eurasian events and 36 noise samples were processed and analyzed during this period. The results were combined with earlier data, when applicable, in order to maximize the data base. (auth)

22571 (AD-784959) DETERMINISTIC APPROACH TO THE PREDICTION OF TELESEISMIC GROUND MOTION FROM NUCLEAR EXPLOSIONS. Final Report, 19 March–31 December 1973. Cherry, J. T.; Bache, T. C.; Archambeau, C. B.; Harkrider, D. G. (Systems, Science and Software, La Jolla, Calif. (USA)). 18 Jan 1974. Contract DNA001-73-C-0167. 161p. (SSS-R-74-2034; DNA-3321F). NTIS $5.00.

Theoretical predictions of teleseismic ground motion from explosions are presented using a deterministic computer model which merges nonlinear shock code calculations in the near-field with seismic code calculations of far-field stress wave propagation through a realistic earth structure. The predicted ground motion given by synthetic seismograms is shown to be in good agreement with observations of body and surface wave motion. (auth)

22572 (AD-785199) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 2. Simulated On-Line Adaptive Processing Results Using Alaska Long Period Array Data. Barnard, T. E. (Texas Instruments, Inc., Dallas (USA)). 23 Oct 1973. Contract F33657-72-C-0725. 299p. NTIS $6.75.

Results obtained from operating an adaptive time-domain maximum-likelihood filtering system on data from the Alaska long-period array (ALPA) are presented. Signal-to-noise gain of adaptive filtering relative to beamsteering was investigated as a function of convergence rate and steer direction. In addition, the effect upon signal-to-noise gain of freezing the adaptive filter set is described. Both on-azimuth and off-azimuth signals were examined to determine how much they are attenuated in the adaptive filter beam in comparison with the beamsteer output. Signal-to-noise gain values presented are measured using beam output traces formed from actual seismic data. Theoretical studies of the effect of floating dc levels and roundoff error are also discussed. (auth)

22573 (AD-785258) COMPARISON OF THE RESULTS OF THE DYNAMIC RESPONSE OF CYLINDRICAL SHELLS BY CHARACTERISTIC AND BY FINITE ELEMENT METHODS: AXISYMMETRIC CASE. Final Report. Matthews, A. T.; Bleich, H. H. (Weidlinger Associates, New York (USA)). 14 Aug 1974. Contract DASA01-71-C-0098. 44p. (DNA-3312F). NTIS $3.25.

The response of an infinitely long cylindrical shell buried in a bi-linear (hysteretic) material was obtained for a pressure pulse, applied to the inner boundary of the shell. The solution was obtained by means of a characteristic approach. Comparison of this solution with one obtained from a computer program for the same configuration using the finite element method is given. Also given are comparisons for a similar configuration, where the pressure is applied at an outer boundary in the medium, the solution of which was described in a previous report. Both sets of comparisons are in very good agreement. Finally, a criterion is given which permits one to judge the order of agreement which is to be expected in other situations, for the case of an incoming wave. (auth)

22574 (AD-785418) INTERPRETATION OF STRONG-MOTION EARTHQUAKE ACCELEROGRAMS: THE BEAR VALLEY EVENT OF 1973. Final Report. Turnbull, L. S. Jr.; Battis, J. C. (Texas Instruments, Inc., Dallas (USA)). 30 Jun 1974. Contract F44620-72-C-0073. 67p. (AFOSR-TR-74-1437). NTIS $3.75.

The solutions to eight earthquakes were obtained from near-field strong-motion accelerograms using Haskell's moving dislocation source model. In particular, the solutions to the San Fernando main shock and three small aftershocks were re-examined using the corrected orientation of the Pacoima Dam instruments. A reasonable match to the observed waveforms for the main event could only be obtained by having a large strikeslip dislocation component on the deeper segments of the fault. Also, new locations and orientations were obtained for the three small aftershocks. Using both Haskell's Model and spectral analysis, the Bear Valley earthquake of June 22, 1973 was examined. Both approaches yielded substantially the same results; a large dislocation on the order of 100 cm over a small fault area of less than 1.0 km^2, with a seismic moment (MO) of 1.2 to 1.5 $\times 10^{25}$ dyne-cm. (auth)

22575 (AD-786174) REACTION RATE DATA NUMBER 46. (General Electric Co., Santa Barbara, Calif. (USA). DASA Information and Analysis Center). Apr 1974. Contract DNA001-74-C-0014. 26p. NTIS $3.75.

Summaries of ongoing research centering around the area of atmospheric reaction kinetics are presented. Transitions, thermochemistry, energy transfer, reactions, and nuclear fireball effects are some topics included. (GRA)

22576 (AD-786483) RESEARCH IN SEISMOLOGY: EARTHQUAKE MAGNITUDES. Nuttli, O. W.; Kim, S. G. (Saint Louis Univ., Mo. (USA)). 19 Jul 1974. Contract F19628-73-C-0269. 32p. (AFCRL-TR-74-0326). NTIS $3.75.

Research on the applicability of the MB : MS method to discriminate between small-magnitude earthquake and explosions in Eurasia is described. The report presents a formula, valid on a world-wide basis, which enables the MS threshold to be lowered to 2.8. When the formula was applied to the data from moderate- to high-yield Eurasian explosions, it was found that the MB : MS curve for those events is the same as for Nevada Test Site events. Data are presented for some presumed Eurasian earthquakes whose MB : MS values place them in the explosion population. (auth)

22577 (AD-786611) HAPREX PLANNING. Memorandum Report, June–December 1973. Hendrick, R. Jr.; Barrett, T. (Mission Research Corp., Santa Barbara, Calif. (USA)). Jun 1974. Contract DAAD05-73-C-0539. 13p. (MRC-R-108; BRL-CR-164). NTIS $3.25.

HAPREX is an ABMDA-sponsored project dealing with studies of the effects of high altitude striated ionization on radar performance. This project employs barium clouds, released at high altitudes, which are ionized by solar radiation and striated by gradient drift forces produced by winds and (E vector) × (E vector) forces. The use of barium was originally sponsored by ARPA under Project Secede. ABMDA continued this sponsorship to assist in the development of assessment and mitigation techniques to optimize EMD radar system performance in a nuclear environment. (GRA)

22578 (AD-786951) DEFENSE NUCLEAR AGENCY REACTION RATE HANDBOOK. Second Edition. Revision No. 2.

(General Electric Co., Philadelphia, Pa. (USA). Space Div.). May 1974. 54p. (DNA-1948H-REV-2). NTIS $4.25.

Many natural and man-made events entail disturbances of the upper atmosphere. Of particular interest is the sequence of deionization phenomena following a nuclear burst. These disturbed regions can be described mathematically with an appropriate computer code designed for a specific function. To describe the deionization of a disturbed region by an appropriate code one must know the source of the disturbance, its duration, the atmospheric species densities, and basic physical and chemical processes involved. Several multispecies codes for the D, E, and F regions are discussed. The dominant reactions and the important species are pointed out for each region. Numerical methods for solving the rate equations are reviewed. Simplified codes with physical and mathematical approximations and the lumped-parameter method are also discussed. (GRA)

22579 (AD-787336) SEISMIC AND EXPLOSION CENTER AS A DUAL EMITTER OF SEISMIC WAVES. Rulev, B. G. 1971. Translated by F. C. Vaughn from pp 65-75 of Mono. Eksperimentalnaya Seismologiya (Sbornik Statei), 1971. (FTD-MT-24-1609-74). 24p. NTIS $3.25.

The following topics are discussed: basic seismic waves and their sources during an explosion; long-period waves during earthquakes; and focus areas during explosions and earthquakes. (GRA)

22580 (AD-787352) OPERATIONAL GUIDE FOR THE AN/TPS-41 RADAR. Final Report, 1 June 1972–31 August 1973. Hiser, H. W. (Miami Univ., Fla. (USA). Rosenstiel School of Marine and Atmospheric Sciences). May 1974. Contract DAAB07-72-C-0218. 109p. (ML-UM-RSMAS-B-7897-2). NTIS $5.25.

The report is an operational guide for the use of the weather radar set, AN/TPS-41 by personnel other than professionally trained meteorologists to collect and interpret meteorological data. The first part of this report provides introductory material on common major components of radars, a discussion of the basic radar formula, and a brief review of radar operation to gain optimum echo observation. The balance of the report covers radarscope interpretation, operational techniques for applying radar data, illustrations of storms observed by radar, and nuclear surveillance. (auth)

22581 (AD-787617) DEVELOPMENT OF A LOW-DENSITY AMMONIUM NITRATE/FUEL OIL EXPLOSIVE AND MODELING OF ITS DETONATION PROPERTIES. Final Report, 25 Oct 1971–30 Dec 1972. McKay, M. W.; Hancock, S. L.; Randall, D. (Physics International Co., San Leandro, Calif. (USA)). Oct 1974. Contract DNA-A001-72-C-0052. 60p. (PIFR-383(Vol.2); DNA-3351F). NTIS $4.25.

A low-density ammonium nitrate/fuel oil (ANFO) explosive was developed by diluting the normal density explosive with low-density polystyrene beads. Stable detonations were achieved in mixtures having densities over the range 0.5 to 0.9 g/cc. The detonation velocity was found to decrease approximately linearly with decreasing density. The explosive was found to have a long reaction time and required large charges with propagation distances on the order of 100 to 150 cm to establish a steady-state detonation. The buildup of the detonation wave to its steady-state velocity was successfully modeled using a grain-burning reaction rate theory with a reaction time constant of 100 μs. A mixture having a density of 0.75 g/cc was selected as the explosive for the Mine Throw II Event and a mathematical model of its detonation properties was developed for use in the charge design calculations. (auth)

22582 (AD-787693) SEISMIC NETWORK SYSTEMS STUDY. Final Report. Briscoe, H. W. (Bolt, Beranek, and Newman, Inc., Cambridge, Mass. (USA)). 9 Aug 1974. Contract F08606-74-C-0028. 84p. (BBN-2865). NTIS $4.75.

Design recommendations by Bolt, Beranek, and Newman for the data collection function of a worldwide seismic data network are presented. Particular attention has been paid to integrating both ARPA network packet switching technology and conventional leased channels. It appears not only feasible but attractive to employ such a mixed approach. The resulting communication system should be reliable, flexible, and cost-effective. Two detailed protocols specify the communications between four remote array sites and a central communications and control processor (CCP) and the communications between the CCP and the seismic network mass storage facility. (auth)

22583 (AWRE-O-52/74) SOME SEISMIC RESULTS OF THE RIO BLANCO EXPLOSION IN THE COLORADO RIVER REGION, USA (SHOT REPORT NO. 5). Gibbs, P. G.; Blamey, C. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Jan 1975. 18p. Dep. NTIS (US Sales Only) $4.00. UK 50 Pence.

Seismological data from the Rio Blanco Event recorded by arrays in Australia, Brazil, Canada, and Scotland, and single seismometers in England and South Africa are reported. (TFD)

22584 (UCRL-51703) NUCLEAR CHEMICAL COPPER MINING: HYDROLOGIC CONSIDERATIONS. Stone, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Nov 1974. Contract W-7405-eng-48. 27p. Dep. NTIS $4.00.

A preliminary hydraulic analysis of underground leakage of liquids to and from regions of ore broken by nuclear explosives for nuclear chemical copper mining has been made. In the absence of field values, reasonable hydraulic properties are assigned to the saturated media. Leakage to a single broken ore region or "chimney" located below the water table and operated at nearly the native hydraulic head in rock of 1 mD permeability is calculated as less than 0.12 l/s (2.01 kpm) after 1 y of operation and less than 0.10 l/s (1.63 gpm) after 5 y. Calculated leakage from a row of 10 closely spaced chimneys is also moderate, ranging from 0.22 l/s (3.65 gpm) outflow after 1 y to 0.10 l/s (1.63 gpm) after 5 y. One-dimensional radionuclide transport by groundwater flow from chimneys is considered. In a homogeneous native medium, ground-water transport of tritium, ^{90}Sr, and ^{137}Cs at concentrations above their $(MPC)_w$ values is limited to no more than 12-m from the chimneys. Even in the presence of transmissive fault zones down gradient from the chimneys, radionuclide transport will not cause widespread concentrations in the ground water above $(MPC)_w$ values. The fate of acid leachate migrating in ground water is considered; the acid leakage should be completely neutralized by reaction with calcium carbonate after flowing only a few metres from the chimneys. It is concluded that chimney rows should be aligned normal to native flow direction, rather than parallel to it, because the chimneys in a row normal to native flow will be under nearly equal heads, and any required manipulation of the water table configuration by pumping or injecting will be easier to manage. Chimney rows should be located so that they do not intersect faults and in areas with low to moderate native hydraulic gradient to minimize the effects of ground-water through-flow. (auth)

22585 WIDE DYNAMIC RANGE OMNIDIRECTIONAL OPTICAL SENSOR FOR DETECTING NUCLEAR DETONATIONS. Weischedel, R. C. (to General Electric Co.). US Patent 3,859,519. 7 Jan 1975. Filed date 3 Apr 1973. 6p.

An optical sensor is described that includes a photosensitive device and a linear network and a logging network connected in series with the photosensitive device and with a potential source so that the photosensitive device will operate in the voltaic mode under conditions of low light and will operate in the photo current mode under conditions of high ambient light to produce a wide dynamic range of sensing of light flashes. The sensor units are particularly adaptable to the ganging of plural sensors with amplifiers to permit the arrangement of the photosensitive devices of the sensors for omnidirectional operation. (Official Gazette)

22586 PEACEFUL USES OF NUCLEAR EXPLOSIONS. Schuricht, V. (Technische Univ., Dresden). Kernenergie; 17: No. 8, 241-248(Aug 1974). (In German).

The status of peaceful uses of nuclear explosions is reviewed. The phenomenology of contained and cratering explosions and the possibilities of predicting explosion effects are presented. Technological, industrial, and scientific applications are discussed. Finally, safety problems are dealt with. (auth)

22587 SEISMIC EFFECTS OF UNDERGROUND EXPLOSIONS. Sadovskii, M. A.; Kostyuchenko, V. N. (Inst. of Earth Physics, Moscow). Dokl. Akad. Nauk SSSR; 215: No. 5, 1097-1100(11 Apr 1974). (In Russian).

The assumption that the frequency range of oscillations and the maximum amplitude of the slip rate are the determining factors in the seismic effects of underground explosions was examined on the basis of new data on the damaging of structures during the Rulison explosion. The results showed a high correlation between the frequency of damage to structures and the slip rate during seismic disturbances. (JSR)

Protective Structures and Equipment

22588 (BNWL-SA-5241) GLOVEBOX EXPERIENCE AT BATTELLE-NORTHWEST. McFall, E. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 30 Apr 1974. Contract AT(45-1)-1830. 5p. (CONF-740490-1). Dep. NTIS $4.00.

From Rocky Flats glove conference; Denver, Colorado, USA (4 Apr 1974).

In 1973 a total of 329 pairs of gloves (with variations in thickness, length, composition and shape) were purchased for use at BNW. Glove environments include alpha, beta, gamma and neutron radiation, various chemicals and solvents, sharp and rough objects, and heat from furnaces and hot plates. Glove failure results from variables such as age, use frequency, storage, type of work and environment. Although Hypalon gloves offer better resistance to chemicals, solvents, heat, radiation and abrasions than neoprene gloves, they are not easily obtained. Leather and asbestos gloves are worn over glovebox gloves for protection when work involves sharp objects and heat. About 75% of all glove failures occur from wear or rupture in the hand portion of the glove. Improvement in glove durability and flexibility is needed. The standard Hanford glove port (8″) is used with a simple change-out technique which provides good contamination control. (auth)

22589 (COO-3049-5, pp 91-93) AIR CLEANING EQUIPMENT DESIGN AND STANDARDIZATION. First, M. W. Dec 1974.

In semiannual progress report, March 1, 1974–August 31, 1974.

The paper reports interviews with four of the largest suppliers of gas adsorption equipment for collection of radioiodine and is an exploration of the current status of research and development and hardware production for this service and a consideration of future programs useful to AEC programs. (auth)

22590 (LA-5873-PR) RESPIRATOR STUDIES FOR THE AEC DIRECTORATE OF REGULATORY STANDARDS. Progress Report, January 1–June 30, 1974. Held, B. J.; Revoir, W. H.; Pritchard, J. A.; Hack, A. L.; Geoffrion, L. A.; Davis, T. O.; Richards, C. P.; Bevis, D. A.; Moore, T. O.; Wheat, L. D.; Hyatt, E. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Major accomplishments during the second half of FY 74 include giving respirator training to AEC Compliance Office personnel, issuing copies of a respirator training video tape on a self-contained breathing apparatus to AEC licensees, completing the script of a respirator training video tape on inspection of air-purifying respirators, issuing a respirator newsletter to AEC Compliance Offices, giving technical information on respirator protection to AEC Compliance Offices and AEC licensees who made requests for help, eliminating a functional problem in an aerosol system used to evaluate respirator performance, completing the establishment of criteria for selecting human test subjects for use in determining respirator performance, and completing the design of a test system to evaluate respirator exhalation valve leakage under both dynamic and static conditions. (auth)

22591 FALLOUT SHELTER. Barnett, F. W. (to R. J. Sechrist, J. J. Hall, F. W. Barnett). Canadian Patent 955,029. 24 Sep 1974. vp.

Radiation protection construction involving the utilization of liquid inflated or solid particle filled flexible base or envelopes which are formed so as to define an enclosed area, either stationary or movable, for the reception of persons, animals, materials, food, etc. The fluid or particle containing envelopes will be collapsible and of a quickly erecting nature. Frame-like supporting structures will normally be utilized in connection with the support of the envelopes, however, support may also be achieved by exerting internal pressure on the envelope. (CA)

22592 VENTILYATSIYA PRI RABOTE S RADIOAKTIVNYMI VESHCHESTVAMI. (Ventilation in Facilities Dealing With Radioactive Substances). Krupchatnikov, V. M. Moscow; Atomizdat (1973). 368p. (In Russian).

The book deals with problems of ventilation equipment for facilities handling radioactive substances. The material presented in the book is based mainly on Soviet experience with designing and operating ventilation systems in this field. The book pays particular attention to the theoretical principles of selecting optimal conditions in the design and operation of ventilation systems protecting the atmosphere from radioactive emissions. The theoretical solutions to ventilation equipment problems considered in the book can also be used in other ventilation systems which require the separation of highly toxic substances in the air. The second edition takes into account the new permissible concentration limits for radioactivity specified in NRB-69 and OSP-72. Sections on purifying ventilation air have been expanded. Material on new types of filters and fire safety measures is presented. (tr-auth)

Vacuum Engineering

Refer also to abstracts 23231 and 23484.

ENVIRONMENTAL AND EARTH SCIENCES

Refer also to abstract 25110.

22593 (JPRS-62763) TRANSLATIONS ON ENVIRONMENTAL QUALITY. Number 48. Translation of Monographs from Various Journals. 53p. NTIS $3.75.

The following subjects are included in the translation: new book analyzes environmental protection in the bloc economy; jellyfish polluting western Baltic area; anti-pollution ventilator devised; scientist isolates virus in polluted bay waters; seminar on ecological problems held in Netanya; gulf waters facing increasing dangers from oil pollution; population explosion, unrestricted dumping creates pollution crisis; new sewage treatment plant will reduce pollution of Orontes River; official urges that plants pay for water used or polluted; pollution control at Kemerovo Chemical Plant described; Soviets participate in "Baltic Week" talks at Rostock; closer control over electronically amplified noise urged; technological, cost-accounting approach to ecology urged; Kempen Nature Preserve fights urbanization; Rhine threatened as drinking water source; Rijnmond waste processing operating at loss; and radioactive materials create dangerous situation. (GRA)

22594 (JPRS-62793) TRANSLATIONS ON ENVIRONMENTAL QUALITY. Number 49. Translation of Monographs from Various Journals. 32p. NTIS $3.25.

The following topics are included in the translation: environmental impact of trans-Amazon highway questioned; nuclear powered station to be built in coming months; water pollution becomes matter of concern; "KUR" invests in ecological improvements; new filter reduces Nesher's pollution; forestry conservation laws need improvement; measures taken in the Azov Sea; preservation of diminishing species; and the Pamir Botanical Garden. (GRA)

22595 (PB-236011) QUARTERLY AWARDS LISTING. Grants Assistance Programs. Third Quarter of Fiscal Year 1974. Report, 1 Jan–1 Apr 1974. (Environmental Protection Agency, Washington, D. C. (USA)). 1 Aug 1974. 93p. (EPA-220-1-74-003). NTIS $4.75.

Environmental protection agency awards for research, demonstration, training, fellowship, state and local assistance, and construction grants programs for air, water, solid waste, pesticides, radiation, and hazardous materials are given. (GRA)

Minerals and Ores

Refer also to abstracts 22658, 22807, and 25046.

22596 (AEC-RD-9) GEOLOGIC STUDY OF URANIUM RESOURCES IN PRECAMBRIAN ROCKS OF THE WESTERN UNITED STATES. An Introduction to the Distribution of Uranium and Thorium in Precambrian Rocks Including the Results of Preliminary Studies in the Southwestern United States. Malan, R. C.; Sterling, D. A. (USAEC Grand Junction Office, Colo. Resource Div.). Jan 1969. 54p. Grand Junction Operations.

In a current study of the Precambrian in the western United States, the Atomic Energy Commission is attempting to determine if there are exploitable uranium resources of Precambrian age and if there are time-space-facies patterns of uranium and thorium enrichment in the Precambrian that are related to the major stratiform uranium deposits in Mesozoic and Cenozoic continental clastic sediments. Results of preliminary studies of the Precambrian in the southwestern United States are summarized. The Precambrian in this region was the provenance for the Late Triassic and Late Jurassic uranium host rocks of the Colorado Plateau. The Precambrian terrane in most of the southwestern United States is composed of a thick geosynclinal sedimentary and volcanic series that was subjected to regional metamorphism and local to widespread plutonism during three events that spanned the period 1.8 b.y. to 1.0 b.y. ago. In igneous rocks of the southwestern United States, gamma spectrometric analyses of 132 bulk samples indicate that uranium and thorium increase systematically from 2.3 ppM eU_3O_8 and 8.5 ppM $eThO_2$ in basic and intermediate rocks to 5.3 ppM eU_3O_8 and 45.0 ppM $eThO_2$ in granites. The maxima in granites are 15.6 ppM eU_3O_8 and 288.0 ppM $eThO_2$. The average content in the lower grade metamorphic rocks is 6.4 ppM eU_3O_8 and 15.5 ppM $eThO_2$; the average content of the higher grade metamorphic rocks is 2.7 ppM eU_3O_8 and 10.7 ppM $eThO_2$. Maxima in the 128 samples of metamorphic rocks are 175 ppM eU_3O_8 and 88.7 ppM $eThO_2$, both in lower grade metamorphic rocks. From the east in New Mexico to the west in southeastern California, the mean uranium and thorium contents increase significantly in igneous and in metamorphic rocks. Nearly all of the 21 bulk samples that contain statistically anomalous amounts of uranium and/or thorium are from west of the 112° meridian near Phoenix. (auth)

22597 (AEC-RD-10) GEOLOGIC STUDY OF URANIUM RESOURCES IN PRECAMBRIAN ROCKS OF THE WESTERN UNITED STATES. Distribution of Uranium and Thorium in Precambrian Rocks of the Western Great Lakes Region. Malan, R. C.; Sterling, D. A. (USAEC Grand Junction Office, Colo. Resource Div.). Jul 1969. 25p. Grand Junction Operations.

Private prospecting and investigations by the U. S. Atomic Energy Commission during the 1950's resulted in the discovery of several uranium and thorium prospects in Precambrian rocks in the western Great Lakes region of the United States. In Wisconsin and in upper Michigan, Lower, Middle, and Upper Precambrian silicic and hyperalkalic plutonic rocks contain anomalous amounts of disseminated radioactive minerals. In upper Michigan, Middle Precambrian metasediments of the Animikie Series contain uranium veins in slate, monazite placers in conglomerate and irregular concentrations of uranium in iron formation adjacent to slate. While none of these prospects contain reserves that are economically mineable at present, some may contain important long range, low grade resources of thorium and uranium. For example, limited sampling indicates that masses of silicic igneous rocks in northeastern Wisconsin may contain 50 to 100 parts per million U_3O_8. This is greater than the uranium content in any of about 250 bulk samples of Precambrian igneous rocks from the Western United States analyzed in this project. A potentially great resource of thorium may exist in the monazite placers in conglomerates of the Goodrich Quartzite (Animikie Series) near Palmer in upper Michigan, but the uranium content is very low. Anomalous amounts of uranium in sparse outcrops of other conglomeratic quartzites of the Animikie warrant additional study, but extensive till cover precludes systematic sampling. (auth)

22598 (AEC-RD-11) GEOLOGIC STUDY OF URANIUM RESOURCES IN PRECAMBRIAN ROCKS OF THE WESTERN UNITED STATES. Distribution of Uranium and Thorium in the Precambrian of the West-Central and Northwest United States. Malan, R. C.; Sterling, D. A. (USAEC Grand Junction Office, Colo. Resource Div.). May 1970. 64p. Grand Junction Operations.

This study of the distribution of uranium and thorium in lithologic, geochronologic, and geographic subdivisions of Precambrian rocks includes data on Colorado, Utah, Wyoming, South Dakota, Montana, Idaho, and Washington. The Precambrian geologic history of this region is divisible into four well-established sedimentary-volcanic cycles spanning the periods .8 to 1.2 b.y. ago, 1.4 to 1.7 b.y. ago, 1.8 to 2.5 b.y. ago, and prior to 2.6 b.y. ago. Most of the sedimentary-volcanic cycles are separated by major orogenies with mean ages of 1.0 b.y. (Pikes Peak event), 1.4 b.y. (Silver Plume-Sherman event), 1.7 b.y. (Boulder Creek event), and 2.6 b.y. (development of Wyoming province). Thorium and uranium in major age groups of plutonic rocks are greatest in rocks of the ~1.4 b.y. Silver Plume-Sherman event in Colorado and southern Wyoming (43.3 ppM Th, 5.3 ppM U) and in rocks of the ~2.6 b.y. old Wyoming province largely in Wyoming (30.4 ppM Th, 4.1 ppM U). The high means of all plutonic rocks in Colorado (30.7 ppM Th, 4.4 ppM U) are similar to those in Wyoming (28.1 ppM Th, 4.0 ppM U). The radioelement means for all Precambrian metamorphic rocks in the west-central and northwest United States are 9.8 ppM Th, 2.3 ppM U, and 1.9% K. From Colorado and Utah on the south to Montana, Idaho, and Washington on the north, the mean thorium content of metamorphic rocks increases slightly but uranium, potassium, and the thorium/uranium ratios exhibit no systematic variation with geographic location. The four mountain ranges in which the mean uranium content of all Precambrian rocks combined is greater than 4 ppM include the Seminoe-Shirley Mountains, the Granite Mountains, the Owl Creek Mountains, all in central Wyoming and the Front Range in Colorado. The strongest determinant of the average uranium and thorium in various ranges is the aerial extent of silicic igneous rocks relative to other rocks. The silicic igneous rocks characteristically contain about twice as much uranium and thorium as intermediate igneous rocks and metamorphic rocks. Reconnaissance sampling indicated 19 locations with greater than 8 ppM U and/or 50 ppM Th including seven in Colorado, 11 in Wyoming, and one in Montana. (auth)

22599 (EPRI-SR-5) URANIUM RESOURCES TO MEET LONG TERM URANIUM REQUIREMENTS. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Nov 1974. 120p. NTIS $5.45.

Certain aspects of uranium supply and demand were analyzed to provide input to decisions regarding the risks and costs associated with the timing of the commercial introduction of fast breeder reactors. Uranium resource estimates are provided in tabular form. Uranium requirements were calculated for the lifetime of all light water reactors ever built. The report is divided into the following sections: extent of domestic exploration, uranium occurrence, statistical data on reserves and resources, analysis of observed data on uranium resources, uranium resource estimates in this study, uranium requirements, and uranium cost-quantity relationships. (MCG)

22600 (GJO-1632) GAMMA RADIATION SPECTRAL SURVEY OF THE JACKSON/GOLIAD FORMATIONS IN TEXAS. Summary Report. (Geodata International, Inc., Dallas, Tex. (USA)). 1974. Contract AT(05-1)-1632. 107p. Geodata International, Inc., Dallas, TX.

Results are reported from an aerial gamma ray and magnetic survey of an area on the Texas Gulf Coast which includes the outcrop of the Jackson-through-Goliad geologic units extending from the Rio Grande River to the Sabine River. The arcuate shaped area was surveyed from an aircraft using large volume radiation detectors with computer-controlled airborne equipment. The airborne data gathered were reduced, using ground-base computer facilities, to give the basic uranium, thorium, and potassium equivalent γ radiation intensities, ratios of these intensities, and total γ ray and earth's magnetic field intensity, correlated as a function of geologic units indicated by the Geologic Atlas of Texas. (CH)

22601 (NP-20314) ASSESSMENT OF URANIUM AND THORIUM RESOURCES IN THE UNITED STATES AND THE EFFECT OF POLICY ALTERNATIVES. Burnham, J. B.; Brown, R. E.; Enderlin, W. I. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. vp.

It was concluded that, in general, uranium and thorium resources in the United States are extensive but new or improved technology and higher prices are required before they will become economically viable. Five specific conclusions reached were: reasonably assured uranium reserves recoverable at a 1974 forward cost of \$15/lb U_3O_8 should be adequate at least through 1985; uranium resources from conventional sandstone deposits recoverable at a 1974 forward cost of \$30/lb U_3O_8 should be adequate to the year 2000; thorium resources should be adequate to supply all conceivable needs through the year 2000; capital and manpower resources may be inadequate in the near future; and production capacity may be inadequate in the short term. Various policy options that could affect the uranium/thorium supply curves are considered and analyzed as they impart exploration, mining, milling, and the environment. (MCG)

22602 (ORNL-tr-2896) STUDIES OF OKLO SAMPLES BY IONIC ANALYSIS. Slodzian, G.; Havette, A. Translated by M. Gerrard from Bull. Inform. Sci. Tech. (Paris); No. 193, 83-86 (1974). 8p. Dep. NTIS $4.00.

Ionic analyses of several Oklo samples showed the distribution of the elements, from which migrations were deduced that could have taken place in the deposit. They also showed a Ca/Pb replacement in the grains. Initial measurements permitted dating the emplacement of the deposit, with a good approximation. (auth)

22603 (PB-236067) RECONNAISSANCE SURVEY OF MINERALOGY AND TRACE ELEMENT CONTENT OF SOME UPPER TERTIARY AND QUATERNARY WATER-LAID TUFFS AND TUFFACEOUS SEDIMENTS IN THE BASIN AND RANGE PROVINCE, WESTERN UNITED STATES. Final Report. Lindsey, D. A. (Geological Survey, Denver, Colo. (USA)). 1974. 37p. (USGS-GD-74-036). NTIS $3.75.

Important mineral resources are known in tuffaceous rocks of late Tertiary age in the basin-and-range province of the western United States. This report summarizes the results of mineralogical and trace element studies of tuffaceous rocks at 13 localities, with emphasis on mineralized tuff. These tuffaceous rocks show potential for uranium, and other metals in the Miocene and Pliocene Siebert tuff at Tonopah, Nev., for lithium in the Miocene and Pliocene Muddy Creek formation of southern Nevada and in Miocene lakebeds of the Opalite Mercury District of Oregon, and for beryllium in the unnamed tuff in Hamblin Valley, Utah. In addition, tuffaceous rocks of the Mojave Desert region possess potential for a wide variety of mineral deposits. The existence of extensive trace element anomalies in tuff adjacent to the Spor Mountain beryllium-fluorspar district suggests that geochemical studies should be a good method for evaluating other tuffaceous rocks for mineral potential. (GRA)

22604 GEOCHEMICAL EXPLORATION METHOD. Pogorski, L. A. Canadian Patent 960,949. 14 Jan 1975. vp.

A method of geochemical prospecting and exploration for valuable subsurface deposits was developed. A method is described for detecting subsurface accumulations, which may contain hydrocarbon deposits such as natural gas, petroleum or bitumen and for detecting locations of radioactive mineral ore deposits such as those of uranium and thorium by analysing small gas samples collected from the soil near the earth's surface and analysing the same for the presence of volatile indicators, especially helium, of such deposits. A technique was developed for collecting gas samples, which provides a sample essentially fractionation free, dilution free, and contamination free. (auth)

22605 PRESENT SITUATION OF URANIUM PROSPECTING AND PRODUCTION IN FRANCE. Com. Naz. Energ. Nucl., Notiz.; 20: No. 11, 51-53(Nov 1974). (In Italian).

The current status of uranium prospecting and production in France is reviewed. (auth)

22606 NUCLEAR ENERGY AND MINING INDUSTRY. Panel Discussion. Albino, G. R.; Robertson, D. S.; Worth, D. J.; Runnalls, O. J. C. pp Paper 504, 16p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 5. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

Topics covered include: the proposed Canadian uranium mining control act; the supply of Canada's domestic requirements of uranium; Canada's responsibility in the world uranium market; taxes; supply–demand relationship for uranium; financing of uranium mining projects; and growth in uranium requirements. (MCG)

22607 IN-SITU ASSAYING FOR URANIUM IN ROCK FORMATIONS. Givens, W. W.; Caldwell, R. L.; Mills, W. R. Jr. (to Mobil Oil Corp.). Canadian Patent 954,982. 17 Sep 1974. vp.

The specification discloses a technique for assaying for delayed fission neutrons from uranium to obtain a quantitative measure of uranium ore grade. In one embodiment, a pulsed neutron source of 14-MeV neutrons and a neutron detector are located in a borehole at the level of a formation of interest. The source is operated cyclically to irradiate the formations with bursts of fast neutrons, and the resulting neutrons from the formations are detected. Measurements are made of those neutrons emitted as a result of neutron fission of uranium. Measurements also are obtained in a non-ore-bearing formation to record the count of delayed neutrons emitted from oxygen when irradiated. These measurements are compared with those obtained in the ore-bearing formations of interest to correct for the effect of the oxygen background. (CA)

22608 EXTRACTION METALLURGY OF URANIUM. Thoumsin, F.; Troch, P. Metallurgie (Mons, Belg.); 13: No. 4, 141-148 (1973). (In French).

The methods generally used for working up U ores (0.05 to 1% U_3O_8) to a level of ~75 to 85% U_3O_8 are described. After the initial crushing and physical enrichment (e.g. flotation) the soluble materials are extracted with acid or alkali and separated by decantation or filtration. Further concentration is obtained by either ion exchange or solvent extraction techniques. The final stage is precipitation, separation, washing and drying of the "yellow cake". The treatment of less concentrated ores using more-recently developed techniques (e.g. in-situ lixiviation in conjunction with specific bacterial activity) is considered briefly. (Metals Abstr.)

22609 DISCOVERY OF URANIFEROUS PRECAMBRIAN CONGLOMERATES AT CHIKMAGALUR, KARNATAKA, INDIA. Rama Rao, B. V. (Dept. of Atomic Energy, Bangalore, India). Curr. Sci. (India); 44: No. 5, 174-175(5 Mar 1975).

The discovery of uranium-bearing conglomerates of Precambrian age at Chikmagalur (13° 19′ 20″ N, 75° 46′ 30″ E; Survey of India toposheet No. 480/15) in Karnataka State is reported and their geological setting, radioactivity, and mineralogy are described. (auth)

22610 ON THE GEOCHEMICAL ZONALITY OF ELEMENTS IN THE HYPERGENESIS ZONE OF URANIUM DEPOSITS. Rossman, G. I.; Sychev, I. V.; Tarkhanova, G. A.; Chesnokov, L. V. Geol. Rud. Mestorozhd.; No. 2, 112-119(Mar 1974). (In Russian).

A method is proposed for recreating the primary zonality of endogenous mineralization in the hypergenesis zone by estimating the content of equivalent uranium U_{eq} in the ore brought in during

formation of hydrothermal mineralization, and by considering ratios of a number of element-indicators not only to total uranium U_T, but also to the equivalent uranium U_{eq}. The experimental studies were carried out on three latent ore bodies of a hydrothermal uranium–molybdenum deposit, lying approximately at an equal depth, but changed to a different degree by the hypergenesis processes. The age of the mineralization is 350 ± 10 million years. The ratio of a number of chalcophyllic elements to uranium is used as an indicating estimate of the erosive action. (INIS)

22611 CALCURANITE: A NEW HYDROXIDE OF URANIUM. Rogova, V. P.; Belova, L. N.; Kiziyarov, G. P.; Kuznetsova, N. N. Zap. Vses. Mineral. Obshchest.; No. 1, 108-109(Jan 1974). (In Russian).

A new uranium hydroxide calcuranite is encountered along with metacalcuranite. The mineral is a brown or orange-brown color; in thin slivers it transmits in yellow tones. The luster is oily to dull matte. The specific gravity is 4.62. The hardness is 4. The material is isotropic, sometimes weakly isotropic N = 1.726 to 1.722; R is ~9%. The chemical composition of two samples is (in wt %): PbO is 2.37 and 1.18; BaO is 2.68 and 10.0; CaO is 5.86 and 6.77; UO_3 is 68.02 and 71.78; As_2O_5 is 0.63 and 0.00; Fe_2O_3 is 0.71 and 0.00; Al_2O_3 is 0.34 and 0.69; Na_2O is 0.60 and 0.00; R_2O is 0.00 and 0.60; SiO_2 is 5.81 and 4.00; ZrO_2 is 0.32 and 0.00; H_2O^+ is 7.05 and 8.00; H_2O^- is 5.31 and 3.03; the sum is 99.70 and 96.05%. The formulas of the mineral are $(Ca_{0.74}Ba_{0.19}Pb_{0.01}Na_{0.08})\ O \cdot 1.7\ UO_3 \cdot 4.8\ H_2O$ and $(Ca_{0.95}Pb_{0.05})\ O \cdot 2\ UO_3 \cdot 5H_2O$. The Roentgenogram of uncalcined calcuranite shows only two lines: 3.406 and 3.050. The principal lines of calcuranite calcined up to 900°C are: 3.367, 3.206, 2.720, 1.974, 1.648, 1.117, 1.044, 1.006 and 0.996. (INIS)

22612 CLASSIFICATION OF URANIUM MINERALS. Povarenykh, A. S.; Bendarzh, M. Geol. Zh. (Russ. Ed.); 34: No. 1, 42-53(Jan 1974). (In Russian).

A presentation is given of the crystalochemical and geochemical classification of uranium minerals including all mineral types discovered in recent years. It is shown that of a total of 137 mineral types only 12 have an endogenous origin, while the remaining 125 belong to exogenous uranium minerals. Most of the mineral types have layer structures. Phosphates, arsenites, hydroxides and silicates predominate among the mineral types in anion composition. Minerals of calcium, lead and copper are dominant according to cation composition. Less abundant are minerals of magnesium, barium and potassium, and even less abundant are minerals containing sodium, iron, aluminum and other metals. (INIS)

Radioactive Effluents

Refer also to abstracts 22053, 22168, 22679, and 25140.

22613 (ORNL-TM-3801) COMPENDIUM OF RADIONUCLIDES FOUND IN LIQUID EFFLUENTS OF NUCLEAR POWER STATIONS. Booth, R. S. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 23p. Dep. NTIS $4.25.

Radionuclides released in liquid effluents from power reactors in quantities high enough to suggest assessing their environmental impact were tabulated and their expected annual releases determined from published measurements and operating experience with 24 light-water reactors through 1972. This standard list of 63 radionuclides was used for preparation of environmental impact statements for nuclear power stations. Use of this list helped ensure completeness in estimating the consequences of radionuclide releases from each reactor without having to consider repeatedly the several hundred radionuclides which could be released. The expected releases and their variations tabulated here were used to verify theoretical releases included in the impact statements for specific reactors. Operating experience shows that the quantities of radionuclides released from similar reactors during any year and from the same reactor for subsequent years can differ by orders of magnitude. However, analysis of measured releases indicates that the probability of a given release decreases inversely with the magnitude of that release. The average amount of ^3H released per year was ~900 Ci for pressurized water reactors (PWRs) and ~25 Ci for boiling water reactors (BWRs). The average release of gross beta and gamma radioactivities (in addition to ^3H) was ~5 Ci/year for PWRs and ~10 Ci/year from BWRs. Average releases of individual radionuclides considered here varied from ~10^{-4} to ~2 Ci/year. (auth)

22614 CONTROL, MONITORING, AND REPORTING OF RADIOACTIVITY IN EFFLUENTS. I. AEC-Owned Facilities. Biles, M. B.; Coffman, F. E. (Atomic Energy Commission, Washington, DC). Nucl. Safety; 16: No. 1, 60-70(1975).

Programs for monitoring and reporting of radioactivity in effluents are maintained at all U.S. Atomic Energy Commission (AEC) facilities discharging concentrations of radioactivity that have potential health and safety or environmental significance. To ensure the effective management and control of effluents is the objective of these programs. The nature and quantities of radioactivity discharged to the environment vary widely from site to site, primarily owing to the wide variety of operations and facilities. Effluent-control programs at AEC sites are primarily based on guidance promulgated by the International Commission on Radiological Protection, the National Council on Radiation Protection, and the Federal Radiation Council. To maintain an overview of its effluent-control practices, the AEC has developed and instituted a computer-based annual effluent-data reporting system to ensure that effluent-control programs are properly maintained. This system has proved to be a very useful internal management tool for evaluating the effectiveness of effluent-control programs and for identifying potential problem areas. An effluent-reduction program that focuses on the reduction of quantities rather than concentrations of radioactivity has resulted in substantial reductions in quantities of radioactivity released from selected facilities. (auth)

22615 CONTROL, MONITORING, AND REPORTING OF RADIOACTIVITY IN EFFLUENTS. II. AEC-Licensed Facilities. Higginbotham, L. B.; Collins, J. T. (Atomic Energy Commission, Washington, DC). Nucl. Safety; 16: No. 1, 71-75(1975).

Programs for control and monitoring of radioactive effluents are required at all facilities regulated by the U. S. Atomic Energy Commission (AEC). Limitations and requirements for control and monitoring of radioactive effluents are expressed in AEC regulations issued under Title 10, Code of Federal Regulations. AEC regulations and policies for control of exposures from radiation and radioactive materials are based primarily on guidance promulgated by the International Commission on Radiation Protection, the National Council on Radiation Protection, and the Federal Radiation Council. Conditions in operating licenses issued by the AEC require appropriate surveillance and monitoring programs as a basis for demonstrating compliance with AEC regulatory limits for the release of radioactive effluents. (auth)

22616 EFFECTS OF THE SHUTDOWN OF A NUCLEAR FUEL REPROCESSING PLANT ON NEARBY STREAMS. Bolton, B. A.; Salerno, M. A.; Hopke, Ph. K. (State Univ. Coll., Fredonia, NY). J. Radioanal. Chem.; 23: No. 1-2, 189-194(1974).

In a study conducted in 1971, levels of tritium were found in Cattaraugus Creek, a stream in Western New York State. This material was attributed to the operation in West Valley, New York of the world's first commercial nuclear fuels reprocessing plant. Several fission fragment isotopes in addition to tritium were also observed in Buttermilk Creek, one of the tributaries of Cattaraugus Creek that runs through the reprocessing plant grounds. The plant ceased processing nuclear fuel in December 1971, and a new set of measurements in these streams were made to assess the effect of the ending of the plant's operation. Substantially lower concentrations of tritium and no fission produced isotopes have been observed. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 22614 and 22615.

22617 (PEL-240) ENVIRONMENTAL RADIOACTIVITY AT THE NATIONAL NUCLEAR RESEARCH CENTRE, PELINDABA. van As, D.; Vleggaar, C. M. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Sep 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

A revised environmental survey program, introduced during 1970 with the emphasis on monitoring of the critical paths of exposure of the general public, was continued in 1973. Results of determinations of both gross radioactivity and individual nuclides in samples of fish and water (which are critical materials for liquid effluent releases) from the Hartbeespoort Dam and from the Crocodile River, are given and discussed. Results of gamma-spectrometric, ^{131}I and ^{90}Sr analyses of milk, the critical material for releases to the atmosphere, are presented. Results are given of regular investigations of the composition of effluent releases. These investigations are performed in order to be able to detect other possible critical nuclides. Levels of deposited and airborne activity from nuclear bomb tests are reported. (auth)

22618 (RLO-2225-T14-7) STUDIES OF THE NATURAL ALPHA-EMITTING RADIOISOTOPES IN MARINE ORGANISMS. Annual Progress Report, 1973–1974. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). 1974. 34p. Dep. NTIS $4.75.

The source of natural ^{210}Pb in marine ecosystems was identified as Ra in the water and the source of ^{210}Po was identified as the atmosphere. The accumulation of ^{210}Pb and ^{210}Po in organisms in fresh water and marine environments was studied. Preliminary measurements were made of Pb, ^{210}Pb, and ^{210}Po in sediment cores from Lake Washington, Puget Sound estuaries, and the Pacific Ocean coastal region to determine their mean residence time in sediments. (CH)

22619 DATA. Section IV. Other Data. Radiat. Data Rep.; 15: No. 12, 802-817(Dec 1974).

Data are presented from routine environmental monitoring activities around selected nuclear facilities. The report includes results of surveillance activities at offsite stations around the Nevada Test Site during July to December 1970; and environmental levels of radioactivity at AEC installations (Los Alamos Scientific Laboratory and Mound Laboratory) during 1972. (ERB)

22620 CANADIAN VIEW OF MONITORING ACTIVITIES. Inhaber, H. (Dept. of Environment, Ottawa). Environ. Sci. Technol.; 9: No. 3, 206-209(Mar 1975).

Topics considered include: monitoring approaches, pollution parameters, number of monitoring sites, and other types of comparison. Materials monitored include gases such as SO_2, CO, nitrogen oxides, metals such as Hg, Rb, Cd, toxins of biological origin, radioisotopes, and waste heat. (MCG)

Atmosphere

Refer also to abstract 22580.

22621 (STH-5/73) REPORT ON THE MONITORING OF THE DISCHARGE OF RADIOACTIVE SUBSTANCES IN THE EXHAUST AIR OF NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC. P. 2. Environmental Monitoring of Nuclear Power Plants With Light-Water Cooled Reactor. Schwibach, J.; Winkelmann, I.; Riedel, H. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). Oct 1973. 31p. (In German). INIS.

All measures taken in the environmental monitoring of nuclear power plants have to meet the requirements and fulfill the tasks mentioned in the paper, and the results have to be published so as to guarantee due information of the public. Most decisive, however, are the measures taken within the nuclear power plant. The proposals presented in this status report regarding the establishment of standard measuring programs for the environmental monitoring of nuclear power plants with light-water cooled reactors are taking this problem into account. The proposals were drafted and decided on with the cooperation of the operators of the nuclear power plants in Kahl, Gundremmingen, Lingen, Obrigheim, Wuergassen, Biblis, and Niederaichbach. (GE)

22622 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 15: No. 12, 792-801(Dec 1974).

The following air and precipitation surveillance activities conducted during July 1974 are reported: gross β radioactivity in surface air and precipitation at selected sites in the USA; gross β radioactivity in air at selected sites in the USA west of the Mississippi River; gross β radioactivity in surface air and precipitation at selected sites in Canada; gross β radioactivity in surface air at selected Pan American sites; and gross β radioactivity in air at selected sites in California. (ERB)

22623 SURVEY OF XENON CONTAMINATION IN A CLINICAL LABORATORY. LeBlanc, A. D.; Johnson, P. C. (Methodist Hospital, Houston, TX). Health Phys.; 28: No. 1, 81-83(Jan 1975).

Two simple methods for monitoring xenon contamination in the laboratory are described. A survey, conducted to determine the sources and extent of xenon levels in the laboratory environment, is reported. A number of sources are identified, the most frequent being leakage around the patient's mouth-piece during the equilibration part of ventilation studies. As a result of the rapid washout of xenon from the laboratory, mean air concentration of xenon did not exceed maximum permissible limits even after significant releases. For the lung study room washout was 23%/min while for the general laboratory, it was 1.2%/min. (auth)

22624 FORMATION OF RADIOACTIVITY SIZE DISTRIBUTIONS IN NUCLEAR BOMB DEBRIS. Storeboe, P. B. (Forsvaret Forskningsinstitutt, Kjeller, Norway). J. Aerosol Sci.; 5: No. 6, 557-577(Nov 1974).

A theoretical study has been made of droplet formation in hot vapour gradually cooled under admixture of air containing particles. Spontaneous nucleation, condensation on existing droplets, and coagulation are treated as simultaneous phenomena. Spontaneous nucleation takes place initially, but gives way to condensation on existing droplets. For nuclear ground explosions, site particles are present in the admixed air. Bomb debris is therefore composed of one particle group developed from spontaneous nucleation and another group strongly affected by admixed particles. Only the latter group contains particles large enough to produce close-in fallout. Its radioactivity size distribution is approximately the admixed particle-number size distribution weighted by linear size raised to a power between 1.1 and 1.5. (auth)

22625 TRITIUM IN ATMOSPHERIC HYDROGEN. Martin, J. D.; Hackett, J. P. (Teledyne Isotopes, Westwood, NJ). Tellus; 26: No. 5, 603-608(1974).

The radioactivity of tritiated hydrogen (HT) in the atmosphere in Westwood, New Jersey was measured at approximately weekly intervals from August 1971 to August 1973. The background level remained constant at approximately 80 tritium atoms per milligram of air. Frequent increases in the activity level of up to an order of magnitude were observed until January 1973. The source(s) of HT which was responsible for the frequent increases apparently ceased as a tropospheric source in January 1973. Possible sources of HT may result from the production and storage of tritium for military purposes or from gaseous releases by the nuclear power industry. (auth)

22626 METHOD OF ALPHA–BETA ACTIVITY MULTIPLE CORRELATION FOR ASSESSMENT OF AIRBORNE RADIOACTIVITY. Ping, T. H.; Piatkowski, A. (Politechnika Warszawska, Poland). Health Phys.; 28: No. 2, 127-138(Feb 1975).

A method of continuous and prompt measurement of long-lived airborne radioactivity concentrations, independent of the stage of non-equilibrium between radon and thoron daughter products as well as from their fluctuation of concentrations in a wide range is proposed. The moving filter technique together with three pairs of α-β detectors is used for air sampling and detection of airborne radioactivity. The method, based on six values of activities measured by three pairs of α-β detectors situated one after the other on the same moving filter-band, allows one to determine the airborne radioactivity concentrations of α and β long-lived radionuclides entirely independently from the natural radioactivity background. (auth)

Soil

22627 DETERMINATION OF THE GAMMA, SUPERFICIAL, SPECIFIC CONTAMINATION OF THE RADIOACTIVE ZONES, WITH THE HELP OF A HELICOPTER. Sirbu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 5, 575-581(1974). (In Rumanian).

The mathematical formula for the determination of the gamma, superficial, specific contamination for radioactive zones in the static case is presented. The calculation error is given. The conditions for measuring in the dynamic case are also discussed. Two diagrams are included. (auth)

22628 SORPTION AND DESORPTION OF ^{137}Cs IN SOILS AND THE EFFECT OF VARIOUS CATIONS ON THEIR PATTERNS. Smierzchalska, K. (Polska Akademia Nauk, Warsaw. Rolnicza Pracownia Izotopowa). Rocz. Nauk Roln., Ser. A; 99: 39-61 (1973). (In Polish).

In laboratory experiments, the sorption and desorption patterns of ^{137}Cs (total, exchangeable and nonexchangeable sorption) were determined in 18 soils. The influence of competing cations NH_4, K or Ca applied at various concentrations (0.01–0.5 N), together with ^{137}Cs, on the sorption of radionuclide in soils were studied. The results of potassium sorbed in soils (determined radiometrically using K-42) constituted the basis for the consideration of selective ^{137}Cs sorption when applied as the cation-pair ^{137}Cs/K. The relative replacing power of cations for ^{137}Cs removal from the soil complexes was investigated using several mono- and bivalent cations (NH_4, K, Rb, Cs-stable, Na, Ca, Mg, H), at various concentrations. ^{137}Cs applied in trace concentrations was almost totally sorbed in mineral soil indicating no differences between values for total sorption, which amounted to 99.5 to 99.9% of the rate added. The differences occurred in the soil capacities for stronger fixation of ^{137}Cs. The soils of greater sorption power released 5 to 27% of adsorbed cesium (exchangeable forms). Nonexchangeable forms of radionuclide in these soil types amounted to 88% as the mean value for 10 soils. In the soils of lower sorption capacities, sandy soils, the fixation of ^{137}Cs was much less;

the exchangeable forms amounted to 60% of the total radionuclide adsorbed. Peat soils sorbed even lower quantities of ^{137}Cs. Some of them sorbed 78 and 89% of the rate added; the exchangeable forms of adsorbed cesium varied from 69 to 83%. The ammonium ions present in the solution together with ^{137}Cs added to soils decreased the sorption of radionuclide more significantly than potassium ions. The influence of both cations depended on their concentration in the solution, as well as on soil types. When the concentration of NH_4 or K ions increased, the sorption of ^{137}Cs decreased much more on sandy soils than on heavier ones. The Ca ions introduced together with ^{137}Cs had no effect on cesium sorption in heavier soils. Their greater influence, reducing ^{137}Cs sorption by 20%, occurred on sandy soils at the highest Ca concentration in the solution (0.5 N). The Ca ions were the most effective on peat soils, where the reduction of ^{137}Cs sorption was remarkable even at their lower concentrations. The investigation of sorption of the ion-pair $^{137}Cs/K$ in the soils proved selective sorption of the radionuclide, which was affected greatly by soil types and potassium concentration. Stronger selective sorption of cesium appeared at low K concentration in solution and on heavier mineral soils. The amounts of ^{137}Cs desorbed from soils depended on the kind and concentration of replacing cation, as well as on soil types. (auth)

Water

Refer also to abstract 22675.

22629 (CEA-N-1745) STUDY OF THE MARINE ENVIRONMENT OF AN ATOMIC PLANT AND OF THE BEHAVIOR OF ITS OUTPUT TRACERS (CIRCULATION, DIFFUSION, SEDIMENTATION). A Proposition for a Gamma Spectrometry Methodology: Equipment Characteristics. Lapicque, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. de la Physique). Sep 1974. 156p. (In French). Dep. NTIS (US Sales Only) $11.00.

The aim of this report is to sum up and to interpret, after a study of hydrology, sedimentology, and of measuring equipments, the results of the main operations carried out in the marine environment of the nuclear fuel reprocessing plant at the Hague Center. The utilization of a shipboard in situ gamma spectrometric assembly studied at the DPh/EP-CFR for use at sea, enables to plot the activity of radioelements cesium-137 and ruthenium-106 with the distance travelled from the source. An original device makes it possible to make measurements while the ship is in transit which constitutes a considerable progress from the operational point of view. The comparison of in situ and in vitro results with a simple mathematical model yields values of the turbulent diffusion coefficient. The figures obtained appear reasonable, as compared with the mean oceanic values for the observation, in fair weather conditions, of such waters as are constantly stirred by current eddies. The relative invariance of the (Ru/Cs) concentration ratio shows, moreover, that, for the time scale of the measurements (about 10 hours) and at the depth which was used (6 to 8 fathoms), the turbulence is such that it compels these tracers to diffuse in a similar way, which also means that preferential sedimentation is impossible. (auth)

22630 (PB-235556) POLLUTED GROUND WATER: A REVIEW OF THE SIGNIFICANT LITERATURE. Environmental Monitoring Series. Todd, D. K.; McNulty, D. E. (General Electric Co., Santa Barbara, Calif. (USA)). Mar 1974. Contract EPA-68-01-0759. 224p. (EPA-600/4-74-001). NTIS $7.25.

A selective review is presented of the literature on man-caused groundwater pollution, including causes and occurrence, procedures for control, and methods for monitoring. References cited by number in the text are listed in complete bibliographic form at the end of the report together with an author index. With few exceptions, the material reviewed is limited to relatively recent published items in the United States. (GRA)

22631 (RLO-2225-T18-7) DISTRIBUTION OF PLUTONIUM AND AMERICIUM IN BIKINI LAGOON. Nevissi, A.; Schell, W. R. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). 5 Mar 1974. Contract AT(45-1)-2225. 32p. Dep. NTIS $4.75.

Important factors that govern the redistribution and transport of radionuclides in the Bikini Atoll Lagoon are particulate size and physico-chemical state. In water samples from Bikini the particulate fraction was collected on 0.3 μ millipore filters and the soluble fraction sorbed onto Aluminum oxide beds. Sediments were collected by grab sampling or by coring. The radionuclides measured include $^{240,239}Pu$ and ^{241}Am. The largest source of radionuclides available for transport as indicated by ^{241}Am and $^{240,239}Pu$ in sediments and water samples reside in the deep water in the northwestern quadrant of the lagoon within approximately 6 kilometers south of the second thermonuclear detonation (Shot Bravo). Small particles and/or ions of radionuclides released at the sediment-water interface are transported by the currents. These particles and ions agglomerate during transport away from the sediment surface. Coagulation with ditritus and incorporation with plankton would cause the effective particulate size to increase. After about 16 years, since the last nuclear test on the Atoll, the radionuclides are neither buried totally in the lagoon sediments nor have they been discharged completely to the ocean. There is a constant circulation and redistribution of the materials in the lagoon enforced by prevailing lagoon currents. The flux of americium and plutonium away from Bikini Atoll and into the North Equatorial Current are calculated to be about 3 Ci ^{241}Am and 6 Ci $^{239,240}Pu$ per year. (auth)

22632 (RLO-2225-T18-11) PLUTONIUM IN AQUEOUS SYSTEMS. Schell, W. R.; Watters, R. L. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology; USAEC Division of Biomedical and Environmental Research, Washington, D. C.). 17 May 1974. Contract AT(45-1)-2225. 26p. Dep. NTIS $4.50.

A review was made of the available information concerning Pu in the aquatic environment. The levels are low and the data on the environmental concentrations in lake and marine environments are very limited. Of particular relevance to biological accumulation processes is the physical-chemical state of Pu. Limited information is available in natural environmental waters. Indications are that the plankton has the highest concentration factors and that the concentration factors decrease with increasing complexity of the organisms. Results of recent studies of ^{239}Pu, ^{240}Pu, and ^{241}Am concentrations in water, sediment, and biota at Bikini and Eniwetok Atolls are given. The water samples measured indicate that Pu exists in the particulate, soluble and colloidal physical-chemical states. The plutonium is being injected into the water column from the sediments and has not been removed from the biogeochemical cycle after 16 years. Concentrations of Pu in vertebrates and invertebrates measured at Eniwetok were low and ranged from .001 to .2 pCi/g wet in fish muscle. Additional data are required to better evaluate the potential hazards to man of Pu in the aquatic environment. A computer program was developed to estimate the final forms of soluble Pu in natural waters under certain conditions of acidity, oxidation potential, and complexing factors. (CH)

22633 DATA. Section II. Water. Radiat. Data. Rep.; 15: No. 12, 783(Dec 1974).

The following water surveillance activities are reported: the gross α and β radioactivity, ^{226}Ra, and ^{90}Sr in drinking water samples from selected interstate carrier supplies in the USA during 1972; the gross α and β radioactivity and tritium content of drinking water samples from selected sites in California, Nevada, and Utah during July 1974; and the ^{89}Sr, ^{90}Sr, ^{226}Ra, ^{238}Pu, ^{239}Pu, ^{234}U, ^{235}U, and ^{238}U content of drinking water samples from selected sites in California, Nevada, and Utah during 1974. (ERB)

22634 STUDY OF SELECTED PARAMETERS AFFECTING THE RADIATION DOSE FROM RADIONUCLIDES IN DRINKING WATER DOWNSTREAM OF THE HANFORD PROJECT. Deham, D. H.; Soldat, J. K. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 28: No. 2, 139-144(Feb 1975).

From 18th annual meeting of the Health Physics Society; Miami, FL (17 Jun 1973).

Studies of some parameters affecting radiation doses received from consumption of water derived from the Columbia River downstream of the Hanford production reactors were performed. Included were measurement of radionuclides in (1) water entering and leaving the water treatment plants at Richland and Pasco, Washington; (2) sanitary (municipal) water at a number of points in Richland; and (3) coffee brewed from sanitary water. The removal efficiencies for the alum-floc water treatment plants studied ranged from 80% for rare-earth nuclides to 10% for ^{51}Cr. The relative concentration of radionuclides (principally ^{24}Na, ^{76}As, ^{122}Sb, ^{239}Np) found within the Richland distribution system was used to estimate the average dose to residents consuming the water. Average GI tract doses calculated for persons residing at each of six locations within the city were $\frac{1}{3}$ to $\frac{1}{2}$ of those calculated for consumption of water leaving the treatment plant. The average dose received, calculated by weighing these six individual doses by the population distribution, yielded 45% of that calculated for consumption of water leaving the treatment plant. Since coffee represents a major liquid intake mode for adults, the volume of coffee consumed and the potential removal of radionuclides during coffee brewing was studied. The average drinkable volume of coffee per cup was 200 ml. The concentrations of radionuclides in the water and coffee brewed from it were not significantly different for those radionuclides contributing the most to the GI tract dose, and hence those doses were not significantly reduced. (auth)

22635 UPTAKE OF BOMB PRODUCED TRITIUM BY THE PACIFIC OCEAN. Michel, R. L. San Diego, CA; Univ. of California (1974). 222p. University Microfilms Order No. 75-4647. Thesis (Ph. D.).

Tritium analyses are reported for 529 samples of Pacific Ocean water. The samples were obtained between 1965 and 1973 from 46 depth profiles extending across the Pacific Ocean from 51°N to 75°S. Samples were analyzed for tritium by gas-proportional counting of ethane prepared from sample water. The water was preenriched by electrolytic reduction. The limits of resolution of the method are 0.1 to 0.2 T.U. Early work on bomb-produced tritium in the oceans indicated that tritium concentrations were highest in the northern latitudes. A longitudinal gradient was also found to be present with higher concentrations in the east. The La Jolla Tritium Laboratory started a program to determine both how and at what rate tritium moved in the Pacific Ocean. In the North Pacific Gyre, tritium distribution below the winter mixed layer seems to be controlled by lateral mixing down to a σ_t of 26.1. Below this level, tritium concentrations drop uniformly with depth. Water with a σ_t greater than 26.1 outcrops only in the northwest Pacific. Thus, penetration of tritium into waters of these densities is slower. In the equatorial Pacific, a distinct maximum tritium concentration is found under the mixed layer in the North Equatorial Current. It is coincident with a salinity maximum that is indicative of water that flows southward from 30°N under the mixed layer. The southward component of flow is computed to be 1.3 + 0.5 cm/sec. In the South Pacific Gyre, tritium concentrations are much lower. In this region, however, tritium is distributed well below the mixed layer due to the sinking of surface water at the Antarctic Convergence. In the Southern Ocean, south of the convergence, most profiles show very little tritium present below the temperature minimum. This indicates the temperature minimum is an effective barrier to downward transport of tritium. Inventories are given of tritium in the upper 500 meters of the Pacific. Tritium content is highest (about 3×10^{20} T-atoms/km^2) in the North Pacific. Tritium inventories drop sharply in the area of the North Equatorial Current and south of 10°N remain constant at about 3×10^{19} T-atoms/km^2. Total tritium present in the World Oceans is estimated to be about 194 kilograms. From this total, it can be estimated that 350 kilograms of tritium were initially produced by nuclear testing. A box model is constructed from surface seawater data collected from the North Pacific. Residence times are given for water in the winter mixed layer at several stations. It is seen that residence times vary significantly from station to station in the North Pacific, but an average residence time of 8.6 to 11.6 years has been calculated from water in the mixed layer of the Pacific Ocean north of 10°N. Eddy diffusion coefficients for vertical and horizontal diffusion were calculated from data gathered at Ocean Station November (30°N, 140°W). Upper limits of 0.27 cm^2/sec and 1.5×10^7 cm^2/sec were obtained for vertical and horizontal eddy diffusion, respectively. (Diss. Abstr. Int., B)

22636 ECOLOGICAL MATTERS IN SANITARY CHARACTERIZATION OF RADIOACTIVE POLLUTION OF NATURAL WATERS. Furnica, G. (Inst. of Hygiene and Public Health, Bucharest). Igiena (Bucharest); No. 4, 193-205(Apr 1974). (In Rumanian).

The behavior of radioactive pollutants in relation to ecological factors and ramifications involving public health is surveyed. The prospects for a sanitary characterization of the radioactively polluted aquatic environment are considered and factors of a program for controlling radioactive pollution are provided. Emphasis is placed on the indices required for a sanitary characterization of the radioactive basins: Limit dose of irradiation of the critical organ; biological and possibly nutritional factors of the individual; factors of ecological transfer from environment to man; intrinsic factors of the receptor environment which determine the balance and concentration of the radionuclide in this environment; intrinsic factors of waste, and the physicochemical form of the radionuclide. The successive stages that permit the estimation of the acceptance capacity for a particular radioelement are discussed. The advantages and drawbacks involved in the samples from water basins which may provide information on radioactive pollution are described. (JPRS)

Ecosystems and Food Cycles

Refer also to abstracts 22640 and 22646.

22637 (BNWL-1877) MAMMALS OF THE HANFORD RESERVATION IN RELATION TO MANAGEMENT OF RADIOACTIVE WASTE. Rickard, W. H.; Hedlund, J. D.; Schreckhise, R. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1974. Contract AT(45-1)-1830. 52p. Dep. NTIS $5.45.

Twenty-four species of mammals, exclusive of bats, are known to occur in or near Hanford waste management areas. Eight of these are important to waste management because of habitat requirements, food habits, burrowing behavior, potential for long-distance dispersal, or positions in ecological food chains. These mammals are muskrat, raccoon, mule deer, coyote, badger, Townsend ground squirrel, black-tailed hare, and the Great Basin pocket mouse. Data concerning population density and home range are available only for the Great Basin pocket mouse. The role of fences as potential barriers to mammal dispersion and migration is discussed. A brief account is given of radionuclide behavior and of the response of mammals to acute ionizing radiation. (auth)

22638 (ORNL-TM-4373) CRITIQUE OF THE FOOD PATHWAYS MODEL IN THE HERMES CODE. Smith, O. L.; Booth, R. S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50.

The HERMES food pathways model developed for the year 2000 study of the impact of radionuclides released to the environment from nuclear power stations upon neighboring populations was evaluated by comparing it with a revised model using basically the same farm management scheme as used by HEDL. In this revised model several approximations used by HEDL were removed and only one new constant was added. A computer code was developed to compare the two models quantitatively. The results show that some HEDL assumptions and mathematical approximations can cause significant conservatism (answers that are too large) in the concentration of radionuclides in farm animal products calculated by their model. The HEDL model calculational error ranged from −15 to +200% (relative to the revised model), for radionuclides with radioactive half-lives greater than ≈8 days and biological half-lives between ≈1 day and ≈30 years. (auth)

22639 (PB-231665-23) SUMMARIES OF FOREIGN GOVERNMENT ENVIRONMENTAL REPORTS. Number 23. (Environmental Protection Agency, Washington, D. C. (USA)). Jul 1974. 77p. NTIS $4.75.

Abstracts concerning environmental problems of air pollution, noise, pesticides, radiation, solid waste, and water pollution are presented. The report focuses on legislative, organizational, economic, and social aspects of environmental protection. (GRA)

22640 (PB-231665-24) SUMMARIES OF FOREIGN GOVERNMENT ENVIRONMENTAL REPORTS. (Environmental Protection Agency, Washington, D. C. (USA)). Aug 1974. 83p. NTIS $4.75.

Abstracts concerning environmental problems of air pollution, noise, pesticides, radiation, solid waste, and water pollution are presented. The report focuses on legislative, organizational, economic, and social aspects of environmental protection. (GRA)

22641 (RLO-2229-T3-2) STUDIES ON THE NUTRITION AND METABOLISM OF REINDEER–CARIBOU IN ALASKA WITH SPECIAL INTEREST IN NUTRITIONAL AND ENVIRONMENTAL ADAPTATION. Progress Report, July 1973–December 1974. Luick, J. R. (Alaska Univ., College (USA). Inst. of Arctic Biology). 7 Oct 1974. Contract AT(45-1)-2229. 114p. Dep. NTIS $8.75.

Basic information is presented on the nutritional and environmental physiology of reindeer and/or caribou with special interest in their reactions and adaptations to diet and climatic stresses. The report summarizes research activities since the last Project Progress Report (June 1973) and consists chiefly of technical reports in five major areas: radioecology, ecosystem studies near Prudhoe Bay, the digestion of native vegetation by reindeer and caribou, the role of lactation in adaptation to nutritional and climatic stresses, and nutrient recycling as a means for water, nitrogen, and nutrient conservation. (CH)

22642 DATA. Section I. Milk and Food. Radiat. Data Rep.; 15: No. 12, 769-777(Dec 1974).

The following milk and food surveillance activities are reported: ^{90}Sr and ^{137}Cs in milk samples from selected sites in the USA, Canada, and Central and South America during July 1974 and the 12-month average for the period from August 1973 through July 1974; ^{137}Cs, ^{90}Sr, ^{89}Sr, and tritium in milk samples from selected sites in California, Nevada, and Utah during July to September 1974; and ^{90}Sr in the diet of New York City, Chicago, and San Francisco during January to December 1973. (ERB)

22643 RELATIONSHIP OF THE STRONTIUM-90 TO CESIUM-137 ACTIVITY RATIO IN MILK TO THE RATE OF FALLOUT FROM NUCLEAR TESTS. Lalit, B. Y. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 27: No. 6, 565-569(Dec 1974).

The activity ratio of ^{90}Sr to ^{137}Cs content in milk and other foodstuffs was studied at many places in the world to enable estimation of ^{90}Sr levels in a sample from its relatively simple ^{137}Cs measurements, thus eliminating the time-consuming ^{90}Sr determination. Activity ratios of $^{90}Sr/^{137}Cs$ in Bombay and Anand milk samples were studied for 1960 to 1971 period. For these places the ratio in milk increases with decrease in the rate of fallout in later years of the measurement period. Survey of similar data from a few other countries of the world for ^{90}Sr and ^{137}Cs content of milk also shows similar trends. This finding is explained on the basis of influence of direct contamination of pastures by these two isotopes during periods of high fallout rate and the preferential entry of ^{137}Cs isotope from pasture to milk through plant-base absorption, light rains, and humid conditions in the atmosphere. This makes the ratio $^{90}Sr/^{137}Cs$ in milk drop as the fallout rate increases. During the period of low fallout rate, ^{90}Sr uptake through soil dominates over that of ^{137}Cs as ^{137}Cs gets fixed to soil and the ratio in milk correspondingly increases. It is suggested that this pattern of variation in the $^{90}Sr/^{137}Cs$ ratio in milk with the rate of fallout should be considered while predicting ^{90}Sr levels in milk from its ^{137}Cs content. (auth)

22644 STUDIES ON THE RADIOACTIVITY OF THE CARCASS OF CARP BRED IN SOUTHERN DISTRICTS OF THE KATOWICE PROVINCE. Karolczyk, J. (Zaklad Higieny Weterynaryjnej, Brynowska, Poland); Kwapulinski, J.; Majchrzyk, H. Acta Hydrobiol.; 15: No. 4, 413-425(1973).

The total β radioactivity, K background, and artificial radioactivity in carp carcasses, plankton, periphyton, bottom sediment, and water in fisheries were measured from 1965 to 1971 in 6 southern districts of the Katowice Province, Poland. The values of the measured parameters were not dependent on the age of the fish or the localization of their breeding. The measured values remained constant throughout the investigation. Plankton, periphyton, and fish have the greatest cumulative capacity for radioactive substances, with phytoplankton having a higher radioactivity than zooplankton. From early stages of its development the carp shows an ability to distinguish radioactive substances in the natural food supply. (Pollut. Abstr.)

Radiometric Techniques

Refer also to abstracts 22039, 22086, 22602, 22604, 22618, 22730, 22809, and 23089.

22645 (CEA-CONF-2755) SOME NUCLEAR METHODS IN ENVIRONMENTAL STUDIES. Fourcy, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondsmentale). 1973. 20p. (CONF-730995-2). Dep. NTIS (US Sales Only) $4.00.

From study group on genetical methods of pest control; Louvain, Belgium (11 Sep 1973).

Applications of neutron activation analysis in the identification of potentially harmful chemical pollutants in environmental samples and applications of radioisotope tracer techniques in studies of the migration of chemical pollutants through food chains to man are discussed. It is pointed out that the main sources of chemical pollutants is their discharge in industrial wastes and the operation of motor vehicles and aircraft. Examples of the use of the techniques described include studies on root and foliar absorption by plants of pesticide residues and their translocation and accumulation in food crops; the cycling of Cr through aquatic ecosystems as an example of heavy metal pollution; and the content of fluorine in the atmosphere, the necrotic effects of F on vegetation, and ^{18}F tracer studies on the migration of F through food chains to cattle, where it causes fluorosis; studies on the content of Br, As, and Cu in pesticide residues; studies on the content of Br and As in cigarettes made from tobacco grown in different countries; and studies on the accumulation of Cu in plants. The advantages of using activation analysis and computer analysis of data for multielement analysis of environmental samples are pointed out. (CH)

22646 (CEA-R-4644) PHYSICO-CHEMICAL BEHAVIOR OF FISSION RUTHENIUM IN THE MARINE ENVIRONMENT. Guegueniat, P. (CEA Centre de La Hague, 50 - Cherbourg (France). Service de Recherches Toxicologiques et Ecologiques). Jan 1975. 209p. (In French). Dep. NTIS (US Sales Only) $13.50.

Thesis. Submitted to Strasbourg Univ., France.

A study was made of the physico-chemical behavior and fate in seawater of ^{106}Ru, a fission product released by nuclear fuel reprocessing plants into the environment as nitrato and nitro complexes of nitrosylruthenium (RuNo). Preliminary investigations on the properties of nitrato complexes in various HNO_3 media were used as a basis to the study on their behavior in seawater, where ^{106}Ru showed two competitive reactions: formation of soluble chloro-derivatives, and hydrolysis leading to the formation of polymers constituent of colloids and semi-colloids. The latter ones occuring mostly in the case of solutions of low specific activity could neither be retained on filters (0.1μ) nor sediment by ultracentrifugation; a procedure based on the use of cationic resins in electrolytic medium was developed in order to study their properties and remove the truly soluble fraction. The soluble forms (3 anionic, 1 neutral, 2 cationic) were bound together by equilibrium reactions that determined the contamination kinetics of the carriers studied (algae, mussels, sediments). Following the fast disappearance, more or less important according to the cases, of some forms (cationic, colloidal, semi-colloidal forms carrying positive charges) the unretained (mainly anionic) were slowly changed into forms that could be retained with a speed always determining a contamination proportional to the logarithm of time. As to nitro-complexes, the contamination of algae and sediments, though resulting from slower reactions, was also proportional to the logarithm of time. Finally, a procedure for the determination of ^{106}Ru in seawater, allowing for the existence of equilibrium reactions, is presented together with some in situ results. (auth)

22647 (RLO-2225-T14-6) SEDIMENTATION RATES AND MEAN RESIDENCE TIMES OF STABLE Pb AND ^{210}Pb IN LAKE WASHINGTON, PUGET SOUND ESTUARIES, AND A COASTAL REGION. Schell, W. R. (Washington Univ., Seattle (USA). Lab. of Radiation Ecology). Jun 1974. Contract AT(45-1)-2225. 44p. Dep. NTIS $5.25.

Core and water samples from Lake Washington and the marine environment of Puget Sound were analyzed for ^{210}Pb and Pb. A systematic evaluation of geochemical processes was made by measuring the sedimentation rates, the density, and the water concentration to evaluate the atmospheric and water contributions of ^{210}Pb and Pb to sediments. The mean residence time was evaluated in the several systems. In Lake Washington the mean residence time of Pb and ^{210}Pb was 70 to 80 days; in the dynamic system of Bellingham Bay the mean residence time was 10 days; in the coastal station the mean residence time was 75 days; at the mouth of the Frazer River the mean residence time was estimated at 80 to 113 days. The sediments reflect the total input from aeolean and pluvial sources. In Lake Washington, the time history is shown by the three sedimentation rates measured: 0.58 mm/year before 1870, 4.5 mm/yr between 1890 to 1916, and 3.1 mm between 1916 and 1972. The stable lead concentrations in the sediments give information on the anthropogenic input to Lake Washington which correlates well with the time history determined by sediment dating. (auth)

22648 VARIATIONS OF CHARACTERISTICS OF FISSION TRACKS IN MUSCOVITES BY THERMAL EFFECTS. Mantovani, M. S. M. (Universidade Estadual de Campinas (Brazil). Instituto de Fisica). Earth Planet. Sci. Lett.; 24: No. 2, 311-316(Dec 1974).

The applicability of the method of uranium fission tracks was studied in a number of sheets from a muscovite of about 600 m.y. Diagrams for fission track density (ρ) versus the chemical etching time (t_A), as well as the larger diameter of the transversal section (D) versus t_A curves were constructed, and the uranium concentration and uniformity of distribution were calculated. Some samples were heated at different constant temperatures for various time intervals, and the features presented by the heated and unheated tracks were analysed. The conclusions can be applied to corrections in age determination of muscovites that suffered natural annealing effects. (auth)

22649 THE Xe–Xe SPECTRUM TECHNIQUE, A NEW DATING METHOD. Shukoljukov, J.; Kirsten, T.; Jessberger, E. K. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Earth Planet. Sci. Lett.; 24: No. 2, 271-281(Dec 1974).

A new method to date uranium-bearing minerals exclusively by means of a mass spectrometric determination of Xe and/or Kr isotopic ratios has been developed and experimentally tested. It is based on the compositional differences between Xe produced by spontaneous fission of ^{238}U in nature and Xe from ^{235}U fission induced by thermal neutrons in a nuclear reactor. Xe is extracted in 5-10 release fractions at successively higher temperatures. This relates the radiogenic Xe contained in various structural elements of different retention characteristics to the respective U concentrations and allows to account for natural Xe losses, which are quite common. A monazite monitor mineral of known age is included in each irradiation and its Xe isotopes are measured in the same way. The samples analyzed include uranium oxides, REE phosphates, tantalum niobates, zircon and others. The results and comparisons with reported ages obtained by other means demonstrate the applicability of the new dating method for

minerals with U contents up to a few percent. In age spectra the low-temperature release fractions of some samples indicate radiogenic Xe losses, while at high temperatures age plateaus can be obtained. (auth)

22650 GEOLOGICAL TIME SCALE. Fitch, F. J. (Birkbeck Coll., London); Forster, S. C.; Miller, J. A. Rep. Progr. Phys.; 37: No. 11, 1433-1496(1974).

The principal aim of the science of geochronology is to present the history of the Earth as a dated sequence of events of known duration. The only available matrix of evidence is that contained within the rocks of the Earth, supplemented to a minor extent by meteorites and by rocks retrieved from the Moon. The primary requirement of geochronology is the erection of a measured geological time scale. Precise physical measurements from which the ages of specific rocks and minerals can be estimated only became possible with the discovery of radioactive decay. Great advances have been made in the last 15 years and the present state of geochronometry is summarized in this paper. There is a brief discussion of the assumptions, accuracy, precision and geological errors inherent in physical geochronometry. The five major physical methods of rock and mineral age determination currently in use are described. The evidence from which an estimate of 4600×10^6 yr for the age of the Earth has been derived is reviewed and the history of the Earth is divided into a number of major cycles. The present knowledge of the geochronology of the last 600×10^6 yr of the Earth's history is based upon a careful combination of the evidence from biostratigraphy and physical geochronometry. This latter, or Phanerozoic, portion of the geological time scale is discussed in detail. It is concluded that geochronology as a science is still in its infancy. A vast amount of age measurement work will have to be done before its principal objectives can be achieved. (auth)

22651 DETERMINATION OF RECENT SEDIMENTATION RATES IN LAKE MICHIGAN USING ^{210}Pb AND ^{137}Cs. Robbins, J. A. (Univ. of Michigan, Ann Arbor); Edgington, D. N. Geochim. Cosmochim. Acta; 39: No. 3, 285-304(Mar 1975).

This paper describes the use of ^{210}Pb and ^{137}Cs radioactivity measurements to determine the rates of sedimentation in the Great Lakes. Cores from eight locations in Lake Michigan were chosen for examination to cover as wide as possible a range of sedimentation rates and representative sedimentary environments. The surficial ^{210}Pb activity in the sediments varies between 7 and 23 pCi/g dry wt and its profile in each core shows the expected exponential decrease with depth consistent with the assumption of uniform sedimentation rate over the last hundred years and secular equilibrium between supported ^{210}Pb and ^{226}Ra (0.5 to 1.0 pCi/g dry wt). Companion measurements of ^{137}Cs indicate that the coring technique satisfactorily recovered the uppermost levels of the deposit and that the mobility of both radionuclides within the sediment is probably small. Based on the limited number of cores analyzed to date, it appears that modern sedimentation rates are not very different from average rates for the last 7000 yr. The excess ^{210}Pb appears to originate primarily from atmospheric fallout, but a further inventory of the ^{210}Pb distribution over the lake bottom must be made to properly assess the significance of other sources. The spatial distributions of both ^{137}Cs and ^{210}Pb at certain stations suggest that the mode of transport of these radionuclides are comparable and involve attachment to settling particles. A mathematical model is developed which accounts for the observed limited mobility of both ^{210}Pb and ^{137}Cs in several of the cores in terms of post-depositional redistribution by physical or biological mixing processes. (auth)

22652 UNBALANCED RATIO OF ACTIVITY OF URANIUM ISOTOPES AS A NATURAL HYDROGEOLOGICAL MARKER. Rozkowska, A.; Rozkowski, A. (Instytut Geologiczny, Warsaw (Poland)). Tech. Poszukiwan; 12: No. 47-48, 40-43(1973). (In Polish).

Research on the possibility of using, for hydrogeological purposes, the technique of radioactive local isotopes, based on measurements of the unbalanced ratio of activity of ^{234}U/^{238}U isotopes in water is discussed. Principles of the method and some examples of the uranium technique used in hydrogeological investigations in the Soviet Union, the USA, and Israel are given. An analysis of the results of the works carried out using the uranium technique demonstrates satisfactory perspectives when introducing this method into hydrogeological research. (auth)

22653 IO/U AGES OF CORALS FROM SAURASHTRA COAST. Gupta, S. K.; Amin, B. S. (Tata Inst. of Fundamental Research, Bombay (India)). Mar. Geol.; 16: No. 5, M79-M83(Jul 1974).

Un-recrystallized fossil corals occurring at 2-6 m above the present mean low-tide level on the Saurashtra coast (Western India) were dated by ^{230}Th/^{234}U and ^{234}U/^{238}U radiometric methods. The measured ages of the corals, which are in agreement with radiocarbon ages, fall in three groups, 6,000, 30,000 and 120,000 years before present. This observation, coinciding with the high sea-level stands reported in several locations in the world, in the absence of evidence in support of instability of Saurashtra coast, suggests that the coral reefs are remnants of one Holocene and two Quaternary high-sea level stands. (INIS)

22654 PLOTNOSTNOJ GAMMA-GAMMA-KAROTAZH RAZREZOV NEFTYANYKH SKVAZHIN (SOSTOYANIE RAZRABOTKI V SSSR I ZA RUBEZHOM). (Density Gamma-Gamma Logging of Petroleum Well Logs (the State of Exploration in the USSR and Abroad)). Gulin, Yu. A. Moscow; VIEHMS (1973). 39p. (In Russian).

Separate problems in the development of gamma-gamma surveying in the USSR and USA are reviewed. Particular attention is devoted to the theory, in particular to the Monte Carlo method, which has become important in studying the physics of gamma-gamma surveying (GGS). A presentation is given of the characteristics of various kinds of native and foreign equipment, and also of patented materials of the USA. The method of interpretation is described briefly. An analytical review is carried out on a new type of GGS equipment-a two-beam, gamma-gamma densitometer. (tr-INIS)

22655 RADIOMETRIYA I YADERNAYA GEOFIZIKA. (Radiometry and Nuclear Geophysics). Gorbushina, L. V.; Zimin, D. F.; Nagiya, V. V.; Ovchinnikov, L. I. Moscow; Nedra (1974). 304p. (In Russian).

A presentation is given of the principles of radiometric and nuclear-geophysical methods used in prospecting for useful mineral deposits, and also the principles of physical-chemical methods of investigating mineral samples. The theoretical principles of these methods and the techniques of field and laboratory studies are considered. Information is presented on the equipment to be used and the rules of operating the equipment. A discussion is presented on the treatment and interpretation of field materials and methods of estimating the quality of the materials, and also the basic conclusions on work protection in studies with sources of ionizing radiation. (tr-INIS)

22656 YADERNAYA GEOGRAFIYA. 2. Nejtronometriya I Kompleksirovanie Metodov Yadernoj Geofiziki. (Nuclear Geophysics. 2. Neutronometry and Complexing of Nuclear Geophysics Methods). Filippov, E. M. (AN SSSR, Novosibirsk. Inst. Geologii I Geofiziki). Novosibirsk; Nauka. Sibirskoe Otdelenie (1973). 400p. (In Russian).

Generalization and systematization are presented on a wide range of material accumulated in the last 10 years on various neutron methods and methods based on the use of powerful nuclear units in geophysics and geology, and also of material on the combined use of radiometric and nuclear-geophysical methods in resolving general geological problems and problems connected with prospecting for combustible fuels, nonmetallic, metallic and radioactive minerals. Significant attention is devoted to the consideration of neutron and photoneutron methods, and also to various pulse methods. A description is given of the schematic arrangement of nuclear units (accelerator, etc.) and their use in studying geological articles under laboratory and field conditions. The first generalization of material is carried out on the use of all possible nuclear methods in the combined study of various geological and geophysical problems. (tr-INIS)

22657 STABILITY ESTIMATION OF THE DATA RESULTING FROM THE DIFFERENTIAL INTERPRETATION OF GAMMA LOGGING. Borzyak, I. P. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Gidrogeologii I Inzhenernoj Geologii, Moscow (USSR)). Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 3, 119-126(1974). (In Russian).

Results of the differential interpretation of gamma-borehole survey data in the presence of gamma-intensity measurement errors and of borehole construction parameters represent a series of uniquely accurate values of metal content with the greatest error in the results obtained for strata with a low concentration of metal adjoining strata with high metal contents, and conversely. (tr-INIS)

22658 RADIOGEOLOGIYA. Uchebnik Dlya Studentov Geologicheskoj Spetsial'nosti Universitetov. (Radiogeology. Text-Book for the Geologic Faculties in Universities). Baranov, V. I.; Titaeva, N. A. (Moskovskij Gosudarstvennyj Univ. (USSR). Geologicheskij Fakul'tet). Moscow; Izd. Moskovskogo Gosudarstvennogo Univ. (1973). 242p. (In Russian).

This book consisting of 10 sections considers the physical bases of radioactivity, methods of investigation in radiogeology, abundances of radioactive isotopes, basic features of the geo-

chemistry of natural radioactive elements, the determination of absolute age, searches for uranium deposits, radiation changes in ores and minerals under the action of natural radioactive radiation and their use in geology. (tr-INIS)

22659 ISPOL'ZOVANIE YADERNYKH METODOV V NEFTEGAZOVOJ GEOLOGII. (Utilizing Nuclear Techniques in Petroleum and Gas Geology). Alekseev, F. A.; Gottikh, R. P.; Lebedev, V. S. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Yadernoj Geofiziki I Geokhimii, Moscow (USSR)). Moscow; Nedra (1973). 384p. (In Russian).

A presentation is made of the problems in using nuclear methods to solve problems of petroleum-gas geology. With large petroleum-gas basins as examples it is shown that it is possible to use regularities in the distribution of natural radioactive elements in ores for the correlation of deposits, a quantitative estimate of the amount of clay in collectors, paleogeographic reconstructions of ancient basins of sedimentation, the manifesting of tectonic structures and the solution of other problems. Detailed consideration is given to problems of the complex use of the isotopic composition of the hydrogen and oxygen composition of subterranean water, the contents of radioactive elements and their decay products to manifest the genesis and dynamics of underground waters, of manifesting the scale of present-day and ancient infiltrations, stagnant zones, and underground water feed and charging zones. The possibilities of solving these problems are demonstrated with an Amudar'inskii petroleum-gas artesian basin as an example. A presentation is given on the regularities in the distribution of carbon isotopes in natural hydrocarbons, and the possibilities are pointed out in using the carbon isotopes to explain the genesis of natural hydrocarbons, paths and kinds of migration and conditions for the formation of oil and gas deposits, establishing the zonality of oil-gas formation, and the possibilities of solving by the methods of nuclear geology both theoretical problems of oil and gas geology, and also practical problems in the search for oil and gas deposits. (tr-INIS)

22660 DETERMINING THE SOURCE OF NITRATE IN GROUNDWATER BY NITROGEN ISOTOPE STUDIES. Kreitler, C. W. Austin, TX; Univ. of Texas (1974). 181p. University Microfilms Order No. 75-4407.

Thesis (Ph. D.).

Nitrogen isotope ratios of ammonium and nitrate ions from soil and water samples can be analyzed reproducibly with an experimental error of approximately ±1‰. Two isotopic ranges of soil nitrate are found in the soils of southern Runnels County, Texas. Nitrate from the decomposition of animal waste nitrogen has a δN^{15} of +10‰ to +22‰. The isotopic ratio is controlled by the volatilization of isotopically light ammonia gas during the decomposition of urea in urine. Nitrate derived from the mineralization of organic nitrogen in cultivated soils has a δN^{15} of +2‰ to +8‰. In southern Runnels County the major source of nitrate in groundwater is natural soil nitrate. The isotopic composition of groundwater nitrate beneath cultivated fields corresponds with δN^{15} of natural soil nitrate. Groundwaters beneath farmhouse-barnyard complexes have a higher average δN^{15}, indicating the addition of animal waste nitrate. Eleven samples of groundwater from Macon County, Missouri, have δN^{15} of +10‰ to +19‰ indicating that the waters are contaminated with nitrate from animal wastes. Nitrates in groundwaters from the Upper Glacial aquifer in Queens County, New York, appear to be from an animal waste source, whereas nitrates in groundwaters from the Magothy aquifer in Nassau County, New York, appear to be from either natural soil nitrogen or artificial fertilizer. (Diss. Abstr. Int., B)

Site Surveys

Refer also to abstracts 22631, 22632, and 24941.

22661 (BNWL-CC-1693) 300 AREA SITE DESCRIPTION. Gustafson, V. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1968. Contract AT(45-1)-1830. 21p. Dep. NTIS $4.25.

The Hanford Works 300 Area covers about 400 acres at the southeast corner of the Hanford reservation, about 1 mile north of Richland, Washington. The facilities, other than those operated by Douglas United Nuclear, are devoted principally to R&D work in support of the Atomic Energy Commission's nuclear programs. This report summarizes the site characteristics relative to an appraisal of the safe performance of nuclear activities in the 300 Area. Data are included on the geology, hydrology, meteorology, and seismology of the area. (CH)

22662 (CONF-720356-1) ENVIRONMENT OF NUCLEAR STATIONS IN ENGLAND AND WALES. Williamson, P. (Central Electricity Generating Board, London (UK)). 1972. 17p. Dep. NTIS (US Sales Only) $4.00.

From proceedings of the 17th nuclear congress; Rome, Italy (23 Mar 1972).

The paper briefly reviews the reasons for siting nearly all the first generation of nuclear power stations in Great Britain on the coast. Partial relaxation of the remote-siting policy in relation to the third and fourth nuclear power stations with advanced gas-cooled reactors (AGR) is discussed and their characteristics are compared with contemporary European stations. The tidal environment of England and Wales is described and recognition is taken of this in the siting and design of coastal nuclear stations, to ensure that the warm water discharge does not cause adverse environmental effects. The control and discharge of radioactive substances and the associated environmental monitoring program is discussed. The paper illustrates the care taken to avoid encroaching unnecessarily on those parts of the coastline which are specially prized for recreational purposes, and discusses some steps which can be taken to make power stations as acceptable as possible to the public. The paper concludes that in future British power stations will be predominantly nuclear. Relaxation of the original remote-siting policy has reduced the visual effects on rural landscapes but, of course, the environmental problems of heated and radioactive discharges remain. Ten years of operational experience with nuclear stations, coupled with the demonstrable independence of the regulatory authorities, has earned the acceptance of the British public and this possibly explains the absence of the sort of opposition which has recently become endemic elsewhere. (auth)

22663 (COO-2138-13) EXPLOSION-INDUCED GROUND MOTION, TIDAL, AND TECTONIC FORCES, AND THEIR RELATIONSHIP TO NATURAL SEISMICITY. Willis, D. E.; Taylor, R. W.; Tatar, P. J.; Torfin, R. D.; Revock, K.; Poetzl, K. G.; George, G. D.; Bufe, C. G. (Wisconsin Univ., Milwaukee (USA). Dept. of Geological Sciences). Dec 1974. Contract AT(11-1)-2138. 332p. Dep. NTIS $19.75.

The natural and man-made forces that influence the seismicity of the Nevada Test Site area and the adjoining regions are reviewed. A comprehensive data file was compiled for earthquakes in the western United States. In excess of 33,000 earthquakes were used to analyze the seismicity of this region over the time period 1852 through 1973. Stereo projections which display earthquake epicenters as a function of geographic location and time were used to investigate trends of seismic activity. Perspective strain release surfaces for given time intervals were constructed to study cumulative strain release as a function of geographic location. Detailed seismicity studies were made for the following areas: the Nevada Test Site area; a region 50 to 1000 km from the Test Site centered on four shots of the megaton range; a portion of central California along the San Andreas fault system which had dense seismograph coverage; and for a small area adjacent to the Test Site where special broad-band high-gain seismographs were used to monitor the seismic activity during a five-week period centered around one of the megaton shots. The results of these studies showed that the underground nuclear testing program did not produce any detectable influence on the natural pattern of earthquake activity except in the immediate areas of the shots. Strainmeter data collected over a two-year period (1970 to 1971) in the Nevada Test Site area showed yearly strain differences of the order of 1×10^{-5} with strain ellipse axes showing maximum compression orientated to the northeast and maximum extension trending to the northwest. (auth)

22664 (DOCKET-408027-12) SEQUOYAH URANIUM HEXAFLUORIDE PLANT. U. S. Nuclear Regulatory Commission's Final Environmental Statement. (Kerr-McGee Corp., Oklahoma City, Okla. (USA)). Feb 1975. 305p. Dep. NTIS $9.25.

The environmental effects of the construction and operation of the Sequoyah Uranium Hexafluoride Plant are examined. The descriptions include: the environment in the area including the regional demography and land use, geography, hydrology, geology, meteorology, ecology, and historic significance; facility and its effluents; impacts from site preparation and construction; impact from operation; probable adverse effects; short-term uses and long-term productivity; benefit-cost evaluation of environmental effects; and alternatives. (JSR)

22665 (PB-233434) CARTY WEST SITE METEOROLOGY. Report for April 1973–March 1974. Prepared by Meteorology Research, Inc., Altedena, CA. (Portland General Electric Co., Oreg. (USA)). Jun 1974. 183p. (PGE-2005). NTIS $5.50.

The purpose of this report is to summarize the local and regional meteorology of the Carty west site and its environs. Onsite

measurements made with an instrumented meteorological tower during the period April 1973 to March 1974 are presented and discussed. Average and extreme values of meteorological parameters are developed and presented. Atmospheric dispersion factors used to assess the safety and environmental impact of a nuclear plant are derived. Models and results are presented on the environmental impact of the use of Carty reservoir as a source of plant cooling water. The onsite meteorological measurement program is described and the overall quality of the program is quantitatively discussed. (GRA)

Thermal Effluents

Refer also to abstract 22620.

22666 (AD-496) HORT-EL-COMPLEX IN SWEDEN. A Brief Design and Feasibility Study of Thermal Horticulture Using Degradation Heat from Thermal Electricity Production. Christensen, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Oct 1974. 85p. Dep. NTIS (US Sales Only) $7.25.

Thermal horiculture combined with electricity production (a hort-el-complex or hortel) was studied in the form of 1,5 km^2 of greenhouses, taking 300 MW heat from a hypothetical electric power plant like unit No 1 at Barsebäck, and producing tomatoes and cucumbers. Using components, techniques, and procedures available today, the project is found to be technically feasible. Based on an investigation of the home market for the products, on indicative tenders from 25 manufacturers or suppliers of components and on data about fuel and electricity prices, the project is also found to be economically feasible. Owing to its large heat capacity the hortel has some capability of satisfying peak demands of electricity. A reasonable credit for this capability balances the additional cost of the turbine plant. Thus the capital cost of the heat delivered to the horticulture from the turbine consists almost exclusively of that of the culvert. The turbine heat costs only 1,7 kr/GJ or less than one seventh of the fuel cost only with oil fired heaters, and there is scarcely anything to gain from lowering the heating steam temperature below 70°C with turbines available today. (auth)

22667 (COO-2374-2) ASSESSMENT OF TECHNIQUES FOR HYDROTHERMAL PREDICTION. Final Report, September 1, 1973-October 31, 1974. Jirka, G. H.; Abraham, G.; Harleman, D. R. F. (Massachusetts Inst. of Tech., Cambridge (USA). Ralph M. Parsons Lab. for Water Resources and Hydrodynamics). 1974. Contract AT(11-1)-2374. 398p. Dep. NTIS $23.00.

A critical assessment was made of techniques, both mathematical models and experimental methods, to predict temperature distribution in the water environment resulting from waste heat releases from steam-electric generation. Such predictions constitute an integral part of environmental impact assessment of power plant facilities. Different types of receiving waters and discharge modes are discussed. Types of receiving waters include lakes, rivers, estuaries, coastal waters and cooling ponds; discharge modes are surface and submerged discharges. Mathematical models are evaluated in regard to their physical validity, degree of field or laboratory verification and computational utility. Predictive techniques are found to be reliable and accurate only if they are applied within limited portions of the temperature field (zone models) and a careful integration is necessary to obtain complete descriptions of the temperature field. This restriction stems from difficulties of representing the variety of heat transport processes in the water environment in a single analytical or experimental technique. Certain models are recommended for use in hydrothermal impact assessment and their limits of applicability have been established. (auth)

22668 (ORNL-tr-2784) CHANGES IN COLOR VALUE, TRANSPARENCY AND OXIDIZABILITY IN THE ZONE AFFECTED BY THE HEATED WATERS OF THE KONAKOVO THERMAL ELECTRIC POWER STATION. Roshchupko, B. F. Translated by H. S. Warren from Biol. Vnutr. Vod, Inform. Byull.; No. 18, 60-64(1973). 4p. Dep. NTIS $4.00.

The inflow into the Ivankovo Reservoir of the heated waters of the Konakovo Thermal Electric Power Station (TEPS) causes not only increased temperature, but contributes to an increased activity in the development of a sequence of chemical and biological processes, including an increase in petroleum products, in assimilation of CO_2, in quantity of bacteria, and in biomass of phytoplankton. Results are reported from studies on the influence of the heated water on the color value, transparency, and oxidizability of the water in the Ivankovo Reservoir at different seasons. (CH)

22669 (ORO-4607-1) EFFECTS OF TEMPERATURE SHOCKS FROM THERMAL PLUMES ON INVERTEBRATE DRIFT ORGANISMS. Progress Report, June 1, 1974-February 1, 1975. Benfield, E. F.; Sherberger, F. F.; Dickson, K. L.; Hendricks, A. C.; Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). 1975. Contract AT(40-1)-4607. 11p. Dep. NTIS $4.00.

This work was based on the premise that stream invertebrates involved in the drift phenomenon will be exposed to short-term temperature shocks when they encounter thermal plumes in rivers. Two basic questions are relevant: are such short-term thermal shocks lethal to the organisms; if the shocks are not immediately lethal, are there lingering or chronic effects on the exposed organisms? Preliminary results using larvae of two aquatic insects (Isonychia soderli and Stenonema ithaca) indicated that at higher acclimation temperatures lower thermal shocks were required to kill the two species under the same duration of exposure. (CH)

22670 (PB-220119) ESTUARINE POLLUTION: A BIBLIOGRAPHY. (Office of Water Resources Research, Washington, D. C. (USA). Water Resources Scientific Information Center). Apr 1973. 510p. (WRSIC-73-205). NTIS $12.50.

The bibliography, containing 324 abstracts and references, is another in a series of planned bibliographies in water resources to be produced from the information base comprising Selected Water Resources Abstracts (SWRA). At the time of search for this bibliography, the data base had 50,631 abstracts covering SWRA through December 15, 1972. The report contains an author index and extensive subject indexes. (GRA)

22671 (PB-221998) WATER REUSE: A BIBLIOGRAPHY. Volume 1. (Office of Water Resources Research, Washington, D. C. (USA). Water Resources Scientific Information Center). Jun 1973. 398p. (WRSIC-73-215(Vol.1)). NTIS $6.00.

This report, containing 263 abstracts, is another in a series of bibliographies on water resources produced from the information base comprising Selected Water Resources Abstracts (SWRA). At the time of search for this bibliography, the data base contained 53,230 abstracts covering SWRA through February 15, 1973 (volume 6, number 4). This volume includes abstracts of documents published through 1969. Author and subject indexes are included. (GRA)

22672 (PB-221999) WATER REUSE: A BIBLIOGRAPHY. Volume 2. (Office of Water Resources Research, Washington, D. C. (USA). Water Resources Scientific Information Center). Jun 1973. 515p. (WRSIC-73-215(Vol.2)). NTIS $6.00.

This report, containing 342 abstracts, is another in a series of bibliographies on water resources produced from the information base comprising Selected Water Resources Abstracts (SWRA). At the time of search for this bibliography, the data base had 53,230 abstracts covering SWRA through February 15, 1973 (volume 6, number 4). This volume includes abstracts of documents published in 1970-1972. Author and subject indexes are included. (GRA)

22673 (PB-222625) THERMAL EFFECTS ON EGGS, LARVAE, AND JUVENILES OF BLUEGILL SUNFISH. Ecological Research Series. Banner, A.; Van Arman, J. A. (Aquatic Sciences, Inc., Boca Raton, Fla. (USA)). May 1973. Contract DI-14-12-913. 118p. (W-73-13020; EPA-R3-73-041). GPO $2.10.

Bioassay experiments were conducted to determine thermal tolerance of early life history stages of bluegill sunfish. Bluegill eggs hatched at temperatures from 18 to 36°C during two incubation tests. Maximal hatch occurred at 22.2 and 23.9°C. Lower TL50 temperature for hatch or normal fry was 21.9°C and upper TL50 temperature was 33.8°C. Juvenile bluegills acclimated to 12.1°C had a lower 96-hour TL50 of 3.2°C and an upper 96-hour TL50 of 27.5°C. Juveniles acclimated to 32.9°C had a lower 96-hour TL50 of 15.3°C and an upper 96-hour TL50 of 37.3°C. TL50 increased with increasing temperature of acclimation. For juveniles acclimated to a given temperature, upper TL50 decreased with longer exposure. A preliminary test determined ranges of thermal tolerance for sac-fry and swim-up fry. In another preliminary test, juvenile bluegills were acclimated to 12.1, 19.0, 26.0, or 32.9°C, and reared at a series of test temperatures for three to six wks. to define optimal temperature ranges for growth and survival. (GRA)

22674 (PB-222962) AERATION OF NATURAL WATERS: A BIBLIOGRAPHY. Knape, G. L. (Office of Water Resources Research, Washington, D. C. (USA). Water Resources Scientific Information Center). Jul 1973. 363p. (WRSIC-73-206; W-73-13651). NTIS $7.75.

The report contains 240 abstracts on improving water quality by artificial aeration. It is another in a series of planned bibliographies in water resources to be produced from the information base comprising Selected Water Resources Abstracts (SWRA).

At the time of search for this bibliography, the data base had 53,230 abstracts covering SWRA through February 15, 1973 (Volume 6, Number 4). Author and subject indexes are included. (GRA)

22675 (PB-223351) SELECTED ANNOTATED BIBLIOGRAPHY ON COLUMBIA AND SNAKE RIVERS. (Washington State Dept. of Ecology, Olympia (USA)). 1973. 362p. (WRIS-INFO-BULL-6). NTIS $7.75.

The bibliography, containing 238 abstracts, was produced by the Water Resources Scientific Information Center from its information base comprising Selected Water Resources Abstracts (SWRA). At the time of search for this bibliography, the data base had 50,631 abstracts covering SWRA through December 1972 (Volume 5, Number 24). Author and subject indexes are included. (GRA)

22676 (PB-231354) MODELING AND OPTIMIZATION OF TRANSIENT COOLING WATER DISCHARGE FROM POWER GENERATING PLANTS. Project Completion Report. Hwang, C. L.; Fan, L. T. (Kansas Water Resources Research Inst., Manhattan (USA)). Dec 1973. Contract DI-14-31-0001-3592. 38p. (CONTRIB-130; W-74-06832). NTIS $3.25.

The present research has yielded a series of publications. They contain the results of: (1) Compilation of water quality data and parameters, and hydrology of Kansas streams and rivers. The compilation could serve as a convenient source of information and should be useful for constructing mathematical models that are relevant to the water quality control and water resource management. (2) The effect of thermal discharge on stream water quality. A modified transient version of the Streeter-Phelps model and of Dobbin's dispersion model along with the energy balance equation is employed to analyze the effects of waste heat discharge from power plants on stream water quality. (3) Water quality control by artificial aeration of stream receiving thermal and organic waste discharges. The location and number of diffuser type aerators to be installed along the stream are determined so as to maintain the stream D^0 content above a certain minimum requirement. (GRA)

22677 (PB-232212) HYDROLOGIC RESPONSE OF ICE-COVERED STREAMS. Completion Report, July 1970-June 1973. Pally, P. P.; Macagno, E. O.; Kennedy, J. F. (Iowa State Water Resources Research Inst., Ames (USA)). Jun 1973. Contract DI-14-31-0001-3280. 38p. (ISWRRI-56; W-74-07832; OWRR-B-061-IA(1)). NTIS $3.25.

The increase in water temperature in natural streams due to waste heat disposal from thermal power plants leads to extensive ice-free reaches during winter periods. Once the hot water is completely mixed with the streamflow, the temperature distribution in the stream is mainly controlled by the surface heat exchange between water and the atmosphere; the mathematical formulation of the temperature distribution is represented by the one-dimensional convection-diffusion equation. A closed-form solution of the one-dimensional unsteady convection-diffusion equation is developed to predict temperature distributions in streams and the lengths of ice-free reaches downstream from the thermal discharge sections. (GRA)

22678 (PB-235783) REVIEW OF THE ENGINEERING ASPECTS OF POWER PLANT DISCHARGES. Technical Report (Final). Daugard, S. J.; Sundaram, T. R. (Hydronautics, Inc., Laurel, Md. (USA)). Oct 1973. 115p. (PPSP-MP-12). NTIS $5.25.

A necessary prerequisite to making assessments of the ecological impact of power plant discharges is a delineation of the engineering factors affecting these discharges. A comprehensive inventory was made of discharges and treatment techniques of fifteen fossil-fueled power plants in the Maryland region. The inventory covers thermal effluents, chemical discharges from cooling and boiler water treatment systems as well as discharges from auxiliary systems. The acquired data are used to assess various control strategies and trade-offs. The improvements required in the state-of-the-art are also given. (GRA)

22679 WATER POLLUTION. McCaull, J.; Crossland, J. (eds.). Environmental Issues Series. New York; Harcourt Brace Jovanovich, Inc. (1974). 218p. $5.50.

The first chapter discusses pollution of Lake Michigan. The following topics are considered: symptomatic treatment of pollution; thermal and radioactive wastes from power plants; and chemical pollution. The second chapter is a discussion of water from the following standpoints: circulation; dependence of living things on water; chemical structure; thermal properties; thermal pollution; salinity; and sediments. Five additional chapters discuss ocean pollution, fresh water pollution, eutrophication in Lake Washington, chemical contamination and biological hazards of drinking water, and water conservation. (HLW)

22680 FISH NUTRITION IN THE COOLER RESERVOIR OF THE LITHUANIAN ELECTRIC POWER STATION. Raciunas, L. A. (Inst. of Zoology and Parasitology, Vilnyus, USSR). Gidrobiol. Zh.; 9: No. 5, 21-27(1973). (In Russian).

Heated water sewage contributed to nutritional reserves formation in the winter, providing fish with food in other seasons. Some differences are found in food organisms' composition between heated and unheated zones. In the heated zone, fish feed actively year-round, showing a high growth rate and a characteristic high fat content. (Pollut. Abstr.)

22681 PHOTOSYNTHETIC PHYTOPLANKTON ACTIVITY IN THE IVANKOVSKOYE RESERVOIR IN THE ZONE OF HEATED WATER FROM THE KONAKOVSKAYA STATE REGIONAL ELECTRIC POWER STATION INFLUENCE. Wainstein, M. B.; Devyatkin, V. G.; Mitropolskaya, I. V. (Inst. of Inner Water Biology, Borok, USSR). Gidrobiol. Zh.; 9: No. 6, 22-29(1973). (In Russian).

In the spring and autumn, algae, which passed through the condensers of Konakovskaya State Regional Electric Power Station, showed no decrease in their photosynthetic activity. However, a slight decrease in activity was observed in some summer periods. The acclimation of the plankton phytocenosis to the heightened water temperature was evident in a flow through the drain channel and Moshkovicheskiy Bay. This flow provided the optimal photosynthetic temperature rise toward the end of the bay. (Pollut. Abstr.)

Chemical Effluents

Refer also to abstracts 22000, 22620, 22645, and 22678.

22682 (AERE-R-7669) SURVEY OF ATMOSPHERIC TRACE ELEMENTS IN THE U.K. (1972-73). Cawse, P. A. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1974. 96p. Dep. NTIS (US Sales Only) $8.00. UK £2.00.

The concentrations of about 30 trace and major elements were determined in air particulates, rainwater, and dry deposition at 7 non-urban sites in the U.K. primarily to investigate the distribution and origin of trace elements and establish the background concentrations. Sampling was continuous over the period Jan. 1972 to Dec. 1973. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 21980, 22023, 22027, 22629, 22830, 22888, 22907, 22976, 23045, 23079, 23457, 23492, 23500, 24340, 24605, and 24725.

22683 (AED-CONF-74-509-011) MEASUREMENTS ON FAST NEUTRON SOURCES WITH LOW EMISSION RATE. Piesch, E.; Burgkhardt, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). 1974. 17p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

A large-area proportional counter, a plastic scintillation counter and a rem-counter were used as a detector for the measurement of the neutron emission rate, the flux density and the absorbed dose rate on neutron sources with emission rates in the order of 500 n/s. The detector characteristics, the background rate and the detector response as a function of distance to the source are given for Am–Be, ^{252}Cf and ^{238}Pu neutrons. (auth)

22684 (COO-3522-3, pp 18-27) GERMANIUM GAMMA CAMERA. Detko, J. F.; Laughlin, J. S. 1973.

In Biological and clinical dosimetry.

Further evaluation tests were performed on the prototype orthogonal strip, ultra pure germanium camera. The camera detector area is 4 cm^2. Tests with a point source of ^{57}Co (122 keV) and ^{99m}Tc (140 keV) phantom demonstrated that the scintillation type cameras cannot match the 4 mm spatial resolution of the germanium camera obtained with in vivo tests on small mammalian organs. In initial stability tests, the germanium camera displayed no ill effects in several cyclings between room temperature and liquid nitrogen. Some deterioration occurred when the cryostat was opened to air. Ultra pure germanium diodes with boron implanted p^+ contacts were constructed from 5 cm diameter material using "in house" facilities. The diodes were evaluated for use in fabrication of an orthogonal strip matrix. A square (10 × 10) orthogonal strip matrix of (3.25 × 3.25) cm^2 area and nearly 9 mm thickness has been constructed and is operational. A single such unit increases the area of the gamma camera detector to almost 11 cm^2 with around 3 mm spatial resolution. Measurements of ^{57}Co (122 keV) show an energy resolution (FWHM) of 4 keV. Tests on stability, electrical and image characteristics, have begun. (auth)

22685 (COO-3522-14, pp 47-68) GERMANIUM GAMMA CAMERA. Detko, J.; Laughlin, J. S. 31 Oct 1974.

In biological and clinical dosimetry. Progress Report, July 1, 1973–June 30, 1974.

The current area of the germanium gamma camera detector is just under 11 cm^2. Evaluation tests revealed serious loss of quantum efficiency with time in the device. This appeared after exposure of the matrix detector to room ambient, an occurrence which is expected in the construction and maintenance of a full scale camera. The cause of the degradation appears to be the result of surface contamination, particularly at the interelectrode regions. A group of test matrix units was constructed from the original (2 × 2 cm) prototype detector and used to evaluate a commercially available passivation technique. Initial results are encouraging with two of four passivated units undetermined after two and four weeks respectively of room ambient storage. Preparations for passivation and testing the current camera detector are in progress. A specially designed electronic monitor system is under commercial construction for use with the germanium camera after further enlargement of the detector. (auth)

22686 (LBL-3617) INITIAL CHARACTERIZATION OF A MULTIWIRE PROPORTIONAL CHAMBER POSITION CAMERA. Lim, C. B.; Chu, D.; Kaufman, L.; Perez-Mendez, V.; Hattner, R.; Price, D. C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 16p. (CONF-741213-12). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

Initial results of a research and development effort on a positron camera utilizing 48 × 48 cm^2 multiwire proportional chambers for detecting the annihilation photons that follow positron decay are described. These photons are detected in the chambers by the photons' interaction with specially configured lead converters placed in close proximity to the chamber wire planes, and the coordinates of the interactions are localized by delay line electronics. A spatial resolution of 6 mm FWHM and a resolving time width of 350 nanoseconds have been achieved. Present sensitivity is of the order of 675 counts/min-μCi, with a maximum data rate of 20K counts/min. Scattering medium in the field of view does not significantly degrade performance. Initial in vivo images demonstrate the potential of this camera. (auth)

22687 POSITION-SENSITIVE SCINTILLATION DETECTORS. Rogers, E. H. Jr.; Whiteside, H. (Federal City College, USA); Arens, J. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nucl. Instrum. Methods; 121: No. 3, 599-604(1 Nov 1974).

The variation of detected light with the position of the light-emitting source has been measured for a number of configurations of plastic scintillator, light pipes, and phototubes. The light source intensity and position can be determined if four phototubes view the scintillators. Strong gradients in detected light as a function of source location were observed which yield a position accuracy adequate for some experiments. (auth)

22688 PULSE-HEIGHT DEFECT OF SILICON SURFACE BARRIER DETECTORS FOR URANIUM IONS IN THE RANGE OF 20 TO 120 MeV. Betz, G.; Isele, H. J.; Roessle, E. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik); Hortig, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Instrum. Methods; 121: No. 3, 589-590(1 Nov 1974).

The pulse-height response of silicon surface barrier detectors has been measured for uranium ions in the energy range of 20 to 120 MeV. The extrapolated zero-energy pulse-height defect was found to be (6.8 ± 0.5) MeV. Moreover a bias dependence of the pulse-height defect was observed. (auth)

22689 A FRAMEWORK FOR RADIATION-CONVERSION TRACK-ETCH IMAGING SYSTEMS ANALYSIS. Harms, A. A.; Moniz, M. S. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Engineering Physics). Nucl. Instrum. Methods; 121: No. 3, 477-482(1 Nov 1974).

A physical-mathematical framework for the study of radiation-conversion track-etch imaging systems is formulated. Several converter arrangements of general interest are considered and the conversion efficiency, as it relates to the optical density formation, is evaluated. Using typical numerical values for the radiation transport parameters, it is found that the back-converter system and the central-converter system are the more efficient conversion systems for track-etch imaging. (auth)

22690 MULTIWIRE COUNTERS FOR A TAGGED BREMSSTRAHLUNG FACILITY. Kim, J. C.; Dixon, G. C.; Drake, T. E.; Knowles, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 121: No. 3, 449-459(1 Nov 1974).

A multiwire counter system for the detection of electrons with better than 50% efficiency has been developed for use in the focal plane of a bremsstrahlung monochromator. A spatial resolution of 3 mm corresponding to a monochromator resolution of 15 keV is achieved with a 4:1 argon-isobutane gas mixture containing 1.3% of electro-negative dichlorodifluoromethane (Freon-12). The "jitter time" with this gas mixture is ~30 ns. A similar multiwire counter system is used to detect fission fragments with nearly 100% efficiency and without pile-up in an alpha background count of 10^6/s. (auth)

22691 DIRECT MEASUREMENT OF NEUTRON DETECTOR EFFICIENCIES. Riddle, R. A. J.; Harrison, G. H.; Roos, P. G. (Maryland Univ., College Park (USA)); Saltmarsh, M. J. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 121: No. 3, 445-447(1 Nov 1974).

The determination of neutron detector efficiencies is essential in obtaining absolute cross sections for neutron-producing reactions. Although various techniques have been used to measure efficiencies, the associated particle technique is probably the most inherently complete and accurate method. The associated particle technique has been used extensively in other neutron measurements. For example, neutron flux from the t(d,n)α reaction has been monitored by detecting the associated α-particles, and neutron energies have been measured in ^3He gas detectors using the $^3He(n,p)t$ reaction. Here initial measurements of neutron detector efficiencies are reported for a single NE102 organic scintillator using the $d(d,n)^3He$ reaction for neutron energies between 25 and 60 MeV. (auth)

22692 CHARGE PLASMA EROSION FOR SHORT-RANGE PARTIALLY AND TOTALLY STRIPPED IONS STOPPED IN SILICON RADIATION DETECTORS. Finch, E. C. (Trinity Coll., Dublin (Ireland). Physical Lab.). Nucl. Instrum. Methods; 121: No. 3, 431-437(1 Nov 1974).

Calculations are made on the erosion by an applied electric field of the charge carrier plasma formed by an ion stopped in a silicon radiation detector. The recent work on this by Seibt, Sundström and Tove is extended to make allowance for the strong variation of linear carrier density with distance along the plasma as produced by partially and totally stripped ions. The published plasma times for 22 MeV ^{16}O ions and ^{252}Cf light fission fragments, both of about 15 μm range, can then be accounted for if transfer from slow cylindrical to fast spherical erosion geometry occurs when a plasma length of about 6 μm remains uneroded. Evidence that this length may be the same for all ions of different ranges is discussed. It is suggested that erosion into the length of a non-uniform plasma column occurs primarily from the end at which the linear carrier density deposited is smaller, although this awaits experimental confirmation. (auth)

22693 A DIGITAL RATEMETER FOR COMPUTER APPLICATIONS. Byrd, J. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nucl. Instrum. Methods; 121: No. 2, 397-403(15 Oct 1974).

A digital ratemeter was developed to measure event pulses from nuclear detectors. Six of these ratemeters are connected to a minicomputer in a counting room at the Savannah River Laboratory (SRL). However, the hardware count-rate circuits operate independently from the computer; the outputs are connected to the computer through a priority interrupt facility. The count-rate circuits operate in a preset time mode or a preset count mode, and the counting time or total counts can be set by computer program control. The circuits are fabricated with complimentary-metal-oxide-semiconductor (CMOS) digital logic modules that have excellent characteristics for nuclear instrumentation. Effective combining of both hardware and software makes a versatile counting system with wide ranges of counting times and total counts. (auth)

22694 RESPONSE OF 3″ × 3″ NaI(Tl) DETECTORS TO TERRESTRIAL GAMMA RADIATION. Loevborg, L.; Kirkegaard, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nucl. Instrum. Methods; 121: No. 2, 239-251(15 Oct 1974).

A 3″ × 3″ NaI(Tl) detector placed in the air or water above a geologic formation (rock or soil) is considered, and a model is established for the emission, transport, and detection of the natural gamma radiation from the formation. Scattered flux components are evaluated by means of a double-P_1 polynomial expansion technique. It is shown that the rate of detection is given by the product of the scalar number flux and the average angular counting cross section for the scintillation crystal. The continuous part of the energy deposition spectrum is derived from parametrized expressions by Berger and Seltzer, whereas photofractions are taken from an evaluation by Snyder. From measurements in water on large concrete slabs containing evenly dispersed radioactive minerals it is demonstrated that the spectrum calculation method is accurate to within 10%. It is also shown that the total count rate above a counting threshold of 0.37 MeV is proportional to the exposure rate (dose rate) at the point of detection. (auth)

22695 ISOTOPIC ANALYSIS OF HIGH ENERGY COSMIC-RAY NUCLEI. Peters, B. (Danish Space Research Inst., Lyngby). Nucl. Instrum. Methods; 121: No. 2, 205-238(15 Oct 1974).

The isotopic and chemical composition of primary cosmic-ray nuclei of a given magnetic rigidity does not change as the particles penetrate the magnetosphere. Their velocity spectra, however, are strongly modified. These modifications depend on the charge-to-mass ratio of each nuclear component. By comparing the velocity spectra of pairs of elements, their isotopic composition can be obtained. A detailed knowledge of geomagnetic cut-off values or of the transmission functions in the penumbra region is not required for such an analysis. The precision of isotopic composition analysis is limited by statistical fluctuation, nuclear interactions, and distortion of the velocity spectra by the measuring instruments. These effects have been evaluated. It is concluded that in the region of rigidities between 3 and 20 GV/c a reasonably dimensioned Cherenkov counter telescope in a near-earth orbit, making use of established techniques, can measure with considerable precision the isotopic composition of the most abundant elements in the primary cosmic radiation including many elements of special interest from the astrophysical point of view. (auth)

22696 THE RESPONSE OF VERY THIN SEMICONDUCTOR DETECTORS TO HEAVY IONS. I. Protons and Helium. Wilken, B. (Max-Planck-Institut fuer Aeronomie, Lindau; Harz (F. R. Germany). Inst. fuer Stratosphaeren-Physik); Fritz, T. A. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Nucl. Instrum. Methods; 121: No. 2, 365-371(15 Oct 1974).

The energy loss of protons and ^3He ions in thin semiconductor detectors with thicknesses of less than 15 μm has been measured as a function of the particle energy. The maximum particle energy used is 2 MeV/charge. A comparison of the measured curves with calculated energy-loss curves using tabulated semi-empirical data shows serious deviations in the neighbourhood of the maximum energy loss ΔE_m. (auth)

22697 DEVELOPMENT OF THIN-FILM PLASTIC SCINTILLATOR DETECTORS FOR USE IN IN-BEAM FISSION STUDIES. Goldstone, P. D.; Malmin, R. E.; Hopkins, F.; Paul, P. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Instrum. Methods; 121: No. 2, 353-358(15 Oct 1974).

Thin-film plastic scintillators have been developed for use as fission detectors in direct-reaction-induced fission experiments. The method of detector fabrication is described. Typical response to fission fragments produced both by a ^{252}Cf source and by charged-particle-induced fission of natural uranium is shown and discussed. (auth)

22698 ENCAPSULATED SCINTILLATION PHOSPHOR. Novak, W. P. US Patent 3,857,036. 24 Dec 1974. Filed date 1 Jun 1972. 8p.

An encapsulated scintillation phosphor wherein a thin foil reflector is fixedly disposed upon and encases all but one surface of the phosphor by means of a shrinkable thermoplastic synthetic resin which is shrink-fitted onto the foil-encased phosphor is described. The one surface not jacketed is that surface through which flashes of light generated within the phosphor are monitored by a photomultiplier tube. (Official Gazette)

22699 ELECTRICALLY INSULATING GAMMA RADIATION SHIELD. Carlson, R. W. (to Kewanee Oil Co.). US Patent 3,858,050. 31 Dec 1974. Filed date 29 Sep 1972. 6p.

In a gamma-ray camera which utilizes a main image intensifier or amplifier tube coupled to a second image amplifier tube, leakage of noise from extraneous sources occurs axially through the zone between the main image tube and a back shield which surrounds the main image tube. Axial leakage is essentially eliminated by an insulating axial shield which jackets the main image tube, the second image tube, and the coupling rings which couple the main image tube to the second image tube. In a specific embodiment, the axial shield is formed by a filled electrically nonconductive resin. Electrically nonconductive heavy metal oxides, such as lead oxide, are preferred fillers. (Official Gazette)

22700 DEVICE FOR MEASURING THE RATE OF ENERGY LOSS AND FOR DETECTING IONIZING NUCLEAR RADIATIONS AGAINST GAMMA-RADIATION BACKGROUND. Kozlov, S. F. US Patent 3,858,047. 31 Dec 1974. Priority date 27 Sep 1968, USSR. 4p.

A device for measuring rates of energy loss and for detecting ionizing nuclear radiation against a gamma-radiation background is described. The nuclear radiation detector is essentially a diamond crystal plate with contacts disposed on its opposite sides and made of a material having an atomic number not exceeding 15, one of said contacts injecting charge carriers and being connected to a detector power supply, while the opposite contact has blocking characteristics in relation to charge carriers and is connected to the input of an amplifier with means for recording output signals. (Official Gazette)

22701 SEMICONDUCTOR LOCALIZATION DETECTOR. Garin, A.; Waast, B. (to Commissariat a l'Energie Atomique). US Patent 3,863,072. 28 Jan 1975. Priority date 19 May 1972, France. 6p.

A semiconductor detector for the localization of particles or radioactive tracers and constituted by a wafer of doped semiconductor material, a metallic thin film being deposited by vacuum evaporation on the rear face of the wafer is described. Doping of the same type as the wafer is accomplished by ion bombardment through the film and at least two metallic contacts are deposited on the rear face after thermal annealing of the wafer. (Official Gazette)

22702 LONG LIFE PROPORTIONAL COUNTER RADIATION DETECTOR. Gleason, C. H.; Bamford, A. J.; Gillies, W. (to Westinghouse Electric Corp.). US Patent 3,860,045. 14 Jan 1975. Filed date 27 Jun 1973. 1p.

A long life gas-filled proportional counter radiation detector is provided having a shielded gas reservoir interconnected with the prime detection chamber. The gas fill within the detection chamber is exposed to radiation but the reservoir gas is shielded to thereby minimize dissociation and absorption of the gas upon the chamber wall. (Official Gazette)

22703 SYSTEM FOR RECORDING AND INTEGRATING TRANSIENT NUCLEAR SCINTILLATIONS. Owens, R. C. Jr. (to Vas Ltd.). US Patent 3,860,822. 14 Jan 1975. Filed date 10 Jan 1973. 4p.

A system for recording transient nuclear scintillations is described comprising a source of nuclear radiation as in a patient, means for detecting and converting the radiation into an electronic display of random scintillating sensible dots disposed with respect to horizontal and vertical axes upon the display, a video camera disposed in alignment with the display for viewing the display directly, a cyclically moving record medium for recording from the video camera, video sync pulses prerecorded on the medium, and means for unblanking the camera to discharge accumulated representations of the scintillations stored on the target of the camera so as to be recorded as a video field on a track of the medium in a manner to be reproduced between successive sync pulses. (Official Gazette)

22704 SCINTILLATION CAMERA WITH LIGHT PIPE INSERTS FOR IMPROVED LINEARITY. Van Dijk, N. (to G. D. Searle and Co.). US Patent 3,859,531. 7 Jan 1975. Filed date 23 Feb 1973. 4p.

An Anger-type scintillation camera having optically coated transparent cones inserted in conical recesses in the scintillator side of the light pipe directly under the seven central photomultiplier tubes is described. The coating on the cones is a thin layer of transparent material with a refractive index considerably lower than that of the light pipe. The cones alter the distribution of light from scintillations occurring at various positions under each of the seven central photomultiplier tubes in such a fashion that the resultant response of the camera system shows considerably improved spatial linearity. (Official Gazette)

22705 APPARATUS AND METHOD FOR PRODUCING IMAGES CORRESPONDING TO PATTERNS OF HIGH ENERGY RADIATION. Luckey, G. W. (to Eastman Kodak Co.). US Patent 3,859,527. 7 Jan 1975. Filed date 2 Jan 1973. 12p.

The disclosure relates to an apparatus and method for recording images on recording mediums which correspond to high energy radiation patterns. A temporary storage medium, such as an infrared-stimulable phosphor or thermoluminescent material, is exposed to an incident pattern of high energy radiation. A time interval after exposure, a small area beam of long wavelength radiation or heat scans the screen to release the stored energy as light. An appropriate sensor receives the light emitted by the screen and produces electrical energy in accordance with the light received. The information carried by the electrical energy is transformed into a recorded image by scanning an information storage medium with a light beam which is intensity modulated in accordance with the electrical energy. Although the invention can be used at any reproduction ratio, it is particularly usable in recording images representative of large format high energy patterns onto microfilm. (Official Gazette)

22706 EFFECT OF COLLIMATOR MOTION ON IMAGE QUALITY IN NUCLEAR MEDICINE. Dowdey, J. E.; Murry, R. C.; Bonte, F. J. (Univ. of Texas, Dallas). Radiology; 114: No. 2, 411-414(Feb 1975).

From 59th scientific assembly of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

To investigate the quality of gamma camera images obtained with moving collimators, a group of collimators was constructed which could be rotated or sinusoidally oscillated in two dimensions. The data indicate a broadening effect on images in the direction of collimator motion. Moving the collimator during imaging will reduce septal aberrations but will not increase resolution. (auth)

22707 NON-IONIC DETERGENTS FOR SOLUBILIZATION OF LIQUID SCINTILLATORS. Lahmann, W.; Hinzpeter, A. (Technische Univ., Hanover). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 515-519(Dec 1974). (In German).

With the help of scintillation counting techniques, detection and spectrometry of β-rays in water solutions were investigated, at high water ratios (50 to 92 vol. %) where the normally useable liquid scintillators cannot be employed. The liquid scintillator (toluene based) is solubilized in the watery radioactive solution. Different solubilizers for toluene scintillators were investigated. Mixtures of two non-ionic detergents proved to be very suitable. With this method it is possible to achieve counting yields of greater than 85% for β-emitters of $\bar{E} > 50$ keV and with a water content of 75%. (auth)

22708 APPLICATIONS OF POSITION-SENSITIVE PROPORTIONAL COUNTERS TO NEUTRON AND X-RAY SCATTERING EXPERIMENTS. Borkowski, C. J.; Kopp, M. K. (Oak Ridge National Lab., TN). J. Appl. Crystallogr.; 7: No. 2, 116(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

The authors review the characteristics of position-sensitive proportional counters (PSPC) with RC line signal encoder [Borkowski, C. J. & Kopp, M. K. (1968). Rev. Sci. Instrum. 39: 1515] and discuss some applications of one- and two-dimensional PSPC's to neutron and x-ray scattering experiments. Compared to other methods, the RC line signal encoding method features relative simplicity in construction and operation plus flexibility in design. Furthermore, these PSPC's show good spatial and energy resolutions, high data-acquisition rates, and good detection efficiency for low-energy (<150 keV) gamma or x-rays and thermal neutrons. The spatial uncertainty with a 200 mm long, one-dimensional PSPC is 0.15 mm (fwhm) for 6 keV x-rays or 5 MeV α particles. For thermal neutrons, the spatial uncertainty is 0.4 mm (fwhm) with a 500 mm long, one-dimensional PSPC. A two-dimensional PSPC of 200 × 200 mm sensitive area has 40,000 resolution elements of 1 × 1 mm each. The energy resolution is 760 eV (fwhm) for 6 keV x-rays. In recent work the authors have extended the data acquisition rate by reducing the signal processing time to 0.5 μs/event while maintaining excellent spatial resolution. (auth)

22709 GAS COUNTERS AS IMAGING SYSTEMS. Tait, W. H. (North East London Polytechnic). J. Inst. Nucl. Eng.; 15: No. 5, 133-139(Sep 1974).

Spark chambers and multiwire proportional counters are well established in the fields of nuclear and high energy physics. Their applications in other areas are reviewed, and the possibilities for their further development as imaging devices are explored. (auth)

22710 IONISATION CHAMBER. Jilbert, P. H. (to National Research Development Corp.). British Patent 1,364,065. 21 Aug 1974. Filed date 11 Aug 1971. 5p.

Reference is made to air-equivalent ionisation chambers. In the chamber described the active volume contacts a surface made of electrically insulating material, with electrically conduction material arranged in a pattern of lines on the surface. The lines occupy only a small proportion of the area of the surface. In one form the chamber is of flat cylindrical shape and is formed by two disks of methyl methacrylate spaced on either of a third disk of the same material. The first two disks carry the polarising electrodes and the third disk carries the collector electrode. Both surfaces of the third disk and the inner surfaces of the first two disks have a pattern of thin concentric and radial conducting lines, intersecting in spider's web fashion, to which the electrical connections are made. These lines may be formed by engraving with a sharp instrument and filling the engraved lines with a conducting material such as colloidal graphite. The small conducting areas provided by the lines suffice to polarise the chamber to saturation and collect all the current produced by ionisation. The arrangement is also applicable to other types of ionisation chambers whose walls are composed of insulating material, for example, tissue-equivalent chambers. (UK)

22711 TESTING OF THE LR-115 KODAK–PATHE RED DYED CELLULOSE NITRATE FOR ALPHA PARTICLE DETECTION. Costa-Ribeiro, C.; Lobao, N. (Rio de Janeiro Univ.). Health Phys.; 28: No. 2, 162-165(Feb 1975).

The efficiency of the LR-115 Kodak-Pathe red dyed cellulose nitrate detector to α particles has been investigated. Parameters examined were: detection efficiency as a function of etching time, stirring of the etching solution and self-induced tracks in non-irradiated cellulose nitrate foils as a function of etching time. Stirring of the etching solution was found to be a very critical procedure when investigating the optimum etching time. The material was found to be an excellent product for quantitative determination of alpha particles, provided that their energies are degraded to values ranging from ≈0.9 to 1.5 MeV. (UK)

22712 MULTIWIRE PROPORTIONAL CHAMBER POSITRON CAMERA: INITIAL RESULTS. Reynolds, R. A.; Snyder, R. E.; Overton, T. R. (Univ. of Alberta, Edmonton, Can.). Phys. Med. Biol.; 20: No. 1, 136-141(Jan 1975).

Multiwire proportional chambers (MWPCs) have a number of potential advantages over scintillation camera systems in imaging

studies in nuclear medicine. When used as position-sensitive detectors in positron tomography, large area lightweight detectors become possible, with comparable sensitivity, improved spatial resolution and reduced cost. A MWPC positron camera system is described, and some initial results in the imaging of simple source distributions presented. (UK)

22713 METHOD FOR DISCRIMINATION OF α- AND β-PARTICLES IN A LIQUID SCINTILLATION COUNTER. Buchtela, K.; Tschurlovits, M.; Unfried, E. (Atominstitut, Vienna). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 551-555(Dec 1974). (In German).

A method for discrimination of α-particles against unknown β-particles in a liquid scintillation counter with the aid of pulse shape discrimination is described. In the energy-range of $0.7 < E_{max} < 1.7$ MeV of β-particles the discrimination error is less than 10%. Suggestions for improvement and for application of the method are given. (auth)

22714 ACCURATE DEAD TIME MEASUREMENT OF SINGLE CHANNEL GAMMA RAY COUNTERS BY MEANS OF THE PROPORTIONAL SOURCE METHOD. Bruninx, E.; Prins, H. J. (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 483-492(Dec 1974).

A method is presented to fit a dead time model to observed count rates. The elimination of errors in the proportional source method, the choice of a correct dead time model based on two dead times θ, τ, the mathematical methods involved in the estimation of the dead times and the stability of dead time as a function of time are examined. It is demonstrated that in this way the aim of the present investigation of measuring true count rates up to 1.5×10^5 s^{-1} with an overall uncertainty of the order of 0.1% is met. (auth)

22715 ISOTOPE ACTIVITY MONITOR. Haskard, D. L. (Univ. of Adelaide). Phys. Med. Biol.; 20: No. 1, 142-143 (Jan 1975).

An instrument for measuring the activity of clinical gamma radiation sources used in intracavitary gynaecological applicators is described. Routine use of this device for checking the sources on loading and unloading of the applicators eliminates the possibility of errors arising from incorrect choice of cesium or cobalt tubes in cases where the identification codes have become faint or difficult to distinguish. Personnel radiation exposure is therefore minimized, and possible errors in tube activity can be detected. The monitor can be calibrated for ^{137}Cs, and also used for checking ^{60}Co sources by reference to monthly source strength tables. (UK)

22716 SEMICONDUCTOR RADIATION DETECTORS. Goulding, F. S.; Pehl, R. H. (Univ. of California, Berkeley). pp 289-343 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Topics include radiation absorption in Si and Ge detectors, charge production and collection processes, detector structures and fabrication aspects, some mechanical and electronic aspects of semiconductor detector spectrometers, and some illustrative detector applications. Radiation damage in semiconductor detectors are briefly discussed, and some new semiconductor detector materials are mentioned. (WHK)

22717 MECHANICAL DEFICIENCIES IN SCINTILLATION COUNTERS, SCANNERS, AND GAMMA CAMERAS. Shaw, A.; Paton, J. S.; Bessent, R. G. (Western Regional Hospital Board, Glasgow). Lancet; No. 7897, 31-32(4 Jan 1975).

After an accident involving a scintillation counter, the mechanical integrity of scintillation counters and their stands, rectilinear scanners, and gamma cameras was examined. An alarming proportion of these devices were found to be poorly designed with consequent danger to patients and staff. This class of equipment should be covered by standards incorporated in a comprehensive hospital technical memorandum. (auth)

22718 DEADTIME OF SCINTILLATION CAMERA SYSTEMS: DEFINITIONS, MEASUREMENT, AND APPLICATIONS. Adams, R.; Jansen, C.; Grames, G. M.; Zimmerman, C. D. (Loma Linda Univ., CA). Med. Phys.; 1: No. 4, 198-203(1974).

Fast quantitative radionuclide dynamic studies of cardiac circulation with scintillation camera systems require deadtime correction. Although such systems are semiparalyzable, they are most conveniently treated either as paralyzable or nonparalyzable. Paralyzing deadtime (τ) is that deadtime during which a system is unable to provide a second output pulse unless there is a time interval of at least τ between two successive events. Paralyzable systems are characterized by Poisson statistics, so that the true counting rate $N = R\,e^{N\tau}$, where R is the observed counting rate. Nonparalyzing deadtime (T) is that deadtime during which a system is insensitive after each observed event. The period of insensitivity is not affected by any additional true events before full recovery occurs. For nonparalyzable systems the corrected counting rate $N = R/(1 - R\,T)$. A two-source method protocol is presented for deadtime measurement. The paralyzing deadtime is calculated by a 5-dimension Newton–Raphson iteration. The nonparalyzing deadtime is calculated by a quadratic equation. Approximation equations are also presented not requiring a computer. Deadtimes are fitted to polynomial equations as dependent variables of measured counting rate. Algorithms incorporating the polynomials are presented for the deadtime correction of histogram curves. Using either the paralyzing or the nonparalyzing approach, precise deadtime corrections are demonstrated. (auth)

22719 OPERATIONS OF PROPORTIONAL X-RAY COUNTERS AT GAS MULTIPLICATION FACTORS CLOSE TO UNITY. Goganov, D. A.; Gimanov, V. P.; Guslina, A. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 972-974(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 39-40(1974).

The characteristics of an x-ray counter operating in a mode close to that of an ionization chamber are described. A charge-sensing preamplifier was used to amplify the signal. (auth)

22720 SPARK DETECTOR FOR RECORDING RECOIL NUCLEI IN INTENSE BEAMS OF GAMMA QUANTA. Zhirova, L. A.; Megrabyan, G. K.; Pikhtelev, R. N. (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 969-971(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 36-38(1974).

A device is described which consists of an ensemble of a spark chamber operating in a driven mode and an α detector situated in the chamber cavity. Exposure of the device in a beam of γ quanta having an intensity of up to 10^9 eq. $\gamma \cdot sec^{-1}$ may be used to determine the interaction point and emission angle of a ^4He recoil nucleus at emission angles close to 90°. (auth)

22721 TEMPERATURE DEPENDENCE AND CHARACTERISTICS OF IONIZATION CHAMBERS WITH A LIQUID DIELECTRIC. Ivanov, V. I.; Kleshchenko, E. D.; Frolov, V. V. (Moscow Engineering-Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 975-978(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 41-43(1974).

A procedure is described for measuring the temperature dependence of the slope angle of the linear segment of the volt–ampere characteristic and the ion-collection efficiency in an ionization chamber filled with a liquid dielectric. The results of measuring these quantities in the 217 to 333°K temperature range are presented. The dependence of the slope angle of the linear segment of the volt–ampere characteristic on temperature can be described well by the Onsager theory of initial (or probable) recombination. (auth)

22722 ION-DOPED SILICON DETECTORS FOR RECORDING SOFT ELECTRONS. Akhmerov, E. E.; Muminov, R. A.; Nigmanov, O.; Shchebiot, U. V. (Inst. of Physics and Tech., Tashkent). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 979-980(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 43-44(1974).

Ion-doped detectors based on low-ohm n-Si are described which are fabricated according to a technology which allows a "guard ring" to be obtained due to a deep p–n junction. It is shown that such a technology allows a substantial increase in the breakdown voltage and permits a reliable contact with the p–n junction to be obtained. The thickness of the sensing region of the detector in the working-voltage range of 100 to 200 V is 5 to 30 μ, and the speed of response is up to 0.1 nsec. The detectors withstand high-vacuum conditions well. (auth)

22723 SPECTROMETRIC CHARGED-PARTICLE DETECTORS BASED ON A SnO_2–Si HETEROJUNCTION. Vakhtel, W. M.; Gorozhankin, V. M.; Evseev, I. I.; Intsertov, A. M.; Kryachko, V. V.; Sukhotin, L. N.; Synorov, V. F. (Voronezh State Univ., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 981-983(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 44-46(1974).

The procedure for producing charged-particle detectors based on a heterojunction is considered along with the detector characteristics. The energy resolution obtained with such detectors amounted to 28 keV for recording α particles from ^{210}Po. (auth)

22724 COMPLETELY DEPLETED DRIFT DETECTORS. Gatsenko, L. S.; Fedoseeva, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 984-985(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 46-48(1974).

Completely depleted silicon detectors having a thickness ranging from 0.4 to 1.0 mm are described which are fabricated according

to the lithium-drift procedure. The features of fabricating and constructing the detectors are considered, as well as various aspects of their application. The principal characteristics of the detectors are presented. (auth)

22725 SILICON SURFACE BARRIER DETECTORS HAVING LOW LEAKAGE CURRENTS. Gumnerova, L.; Osipenko, B. P.; Permyakova, L. A.; Prakhov, N. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 986-989(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 48-51(1974).

A technology is proposed for fabricating silicon surface-barrier detectors from high-ohm n-Si which ensures practically a 100% yield of working devices having a high energy resolution, back currents of ~1 μA at 1000 V, and working voltages of 250 and 600 V at 20 and −100°C, respectively. (auth)

22726 ADJUSTMENT AND INDICATING SYSTEM DESIGNED MAINLY FOR ADJUSTMENT AND INDICATION OF THRESHOLD VALUE IN NUCLEAR PHYSICS INSTRUMENTS FOR RADIATION MEASUREMENT. Sprenger, H.; Mueller, W.; Moehring, R. Czech Patent 149,566. 27 Oct 1972. 5p. (In Czech).

Right of priority for the German Democratic Republic as of 10 Nov 1970 (WP 21g/151 161).

An adjustment and indicating system is proposed suitable especially for the adjustment and the indication of the threshold value in small portable devices for radiation detection. A measuring drum scale on which threshold values are helically plotted is connected by a helical gear to the control element. Electronic connections in the system are designed for sensitivity changes by a factor of 10, 100, etc. (INIS)

22727 n-γ SEPARATION CIRCUIT FOR A FLOW-NEUTRON LIQUID SCINTILLATION DETECTOR. Semenova, N. N.; Kitaev, V. Ya. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 992-995(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 53-56(1974).

An n-γ-separation circuit is proposed for a liquid scintillation detector containing boron; the circuit is based on comparing the fast and slow components of the current pulse which are produced by a linear gate. The circuit of the instrument and the spectra of pulses from a slow-neutron source Pu + Be and a γ ray source ^{137}Cs is presented in which pulse-shaped discrimination is present and absent for two counters having different volumes. (auth)

22728 AMPLITUDE-DIGITAL CONVERTER WITH 8192 CHANNELS AND EQUALIZATION. Gonchar, A. I.; Chubarov, S. I.; Nesterov, B. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1011-1014(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 69-71(1974).

The integral nonlinearity introduced by the charging diode of a charge-discharge device in an 8192-channel amplitude-digital converter due to the dependence of the diode capacitance on the magnitude of the applied inverse voltage is estimated. A circuit is presented for eliminating the nonuniformity of the width of the even and odd channels of the converter, which allows a differential conversion nonlinearity of at worst ±1.3% to be obtained for a channel width of 1 mV. The amplitude-digital converter is for use with a semiconductor detector. (auth)

22729 STUDIES ON THE PERFORMANCE OF COLLIMATORS OF ECIL MEDICAL RADIOISOTOPE SCANNER. Narayanan, R. V.; John, R.; Kochhar, B. R. (Institute of Nuclear Medicine and Allied Sciences, Delhi (India)); Goel, P. K. (Army Hospital, Delhi (India). Radiation Medicine Centre). Indian J. Radiol.; 27: No. 1, 43-46(Feb 1973).

The performance of three collimators supplied with ECIL Medical Radioisotope Scanner was evaluated by determining the Line Spread functions and Modulation Transfer functions (MTF) as recommended by the ICRU report on sensitivity and resolution in radioisotope scanning. The isotopes used were ^{141}Ce, ^{203}Hg, ^{131}I and ^{137}Cs. The results are discussed. (auth)

22730 DETERMINATION OF STATISTICAL MATHEMATICAL EXPECTATION OF INTENSITY FROM THE RADIOACTIVE LOG DIAGRAMS. Iskanderov, V. G.; Putkaradze, L. A. Azerb. Neft. Khoz.; No. 3, 13-15(1973). (In Russian).

A presentation is given on the results of studies associated with estimating the statistical accuracy of low count rates in strata while taking into account the inertia of the radioactive survey equipment, which is determined by the mode of measurement and by the effect of the survey count registers. (tr-INIS)

22731 PREPARATION AND CHARACTERIZATION OF NEUTRON DOSIMETER MATERIALS. Adair, H. L.; Kobisk, E. H. (Oak Ridge National Lab., TN). Nucl. Technol.; 25: No. 2, 224-236(Feb 1975).

The Isotopes Division of Oak Ridge National Laboratory has developed procedures for providing accurately defined deposits of $^{239}PuO_2$ and $^{235}UO_2$ for use in precision neutron cross-section measurements. Encapsulated samples of ^{6}Li, ^{10}B, ^{45}Sc, ^{232}Th, ^{235}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, and ^{241}Pu for use as neutron monitors in reactors can also be provided. These dosimeters are used to determine integral reaction rates from which the neutron energy spectrum, flux, and fluence at particular locations within a reactor can be computed. Methods for the preparation and characterization of reactor dosimeters and other reaction rate samples provide an accuracy of ≤±1% at the 95% confidence level. (auth)

Radiation Dosimeters

Refer also to abstract 23051.

22732 (AED-CONF-74-509-008) CHARACTERISTICS OF DIFFERENT IONIZATION CHAMBERS FOR FAST NEUTRON DOSIMETRY. Kuehn, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Frankfurt am Main (F. R. Germany)). 1974. 27p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

Some characteristic features of different ionization chambers including inhomogeneous chambers employed for the determination of neutron and gamma doses are reported. Especially the influence of the wall materials on the ionization within the chamber gas has been investigated by irradiating parallel plate extrapolation chambers with different gas fillings. Ratios of average mass energy absorption coefficients of some gases determined with the ionization method are compared with data from the literature for 3.3 and 15 MeV neutrons. (auth)

22733 (AED-CONF-74-509-013) MEASUREMENT OF DOSE COMPONENTS IN AN n-γ FIELD. Attix, F. H.; Theus, R. B.; Rogers, C. C. 1974. 8p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

A procedure has been originated for the precise measurement of the n/γ sensitivity ratio for any gamma-ray dosimeter, making use of the neutron beam of interest. The γ-ray dose component in the beam is simultaneously determined with greater accuracy than formerly achievable. The key feature of the technique is the use of a lead filter to remove most of the γ rays from the beam while passing the neutrons. The technique as demonstrated involves six measurements made at a single point in the beam; three with a TE-gas-filled TE plastic chamber, and three with an air-filled graphite chamber. With each of the two chambers a measurement is made a) in the unfiltered beam, b) in the beam filtered by a suitable thickness of lead, and c) in the residual field at the same point with the beam port completely plugged. It is then possible to write six simultaneous linear equations which can be simply solved to obtain the quantities of interest. (auth)

22734 (CNAEM-R-122) PRACTICAL STUDIES OF A THERMOLUMINESCENT DOSIMETRY READOUT SYSTEM AND THE APPLICATION OF THERMOLUMINESCENT DOSIMETRY TO INTERFACES. Koeksal, E. M. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). Dec 1973. 57p. Dep. NTIS (US Sales Only) $6.00.

Thesis.

The performance of the thermoluminescent dosimetry (TLD) system in the Radiation Laboratories of the Physics Department at the University of Surrey was evaluated in detail and found to be inadequate for accurate dosimetry in the millirad region due to a variety of factors. Following this initial investigation, the equipment was substantially redesigned, and the improved system was shown to be capable of accurate dose measurements down to about 10 millirads using 44 mg samples of LiF-700 powder. This system was applied to the problem of interface dosimetry and dose-distributions in the vicinity of a copper-polythene interface were determined for ^{60}Co γ-radiation, and the results were found to be comparable to those of other workers using different methods. A brief comparative survey of commercially available TLD readers has also been included. (auth)

22735 (COO-3522-3) BIOLOGICAL AND CLINICAL DOSIMETRY. Annual Progress Report, July 1, 1972-June 30, 1973. Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 1973. Contract AT(11-1)-3522. 62p. Dep. NTIS $6.25.

Separate abstracts were prepared for the four sections presented. (WHK)

For abstracts of individual sections see: 22684, 22736, 22737, and 23485.

22736 (COO-3522-3, pp 13-15) CONSTRUCTION AND TESTING OF A TISSUE EQUIVALENT ABSORBED DOSE CALORIMETER FOR FAST NEUTRONS. Canada, T. R.; McDonald, J. C.; Mittleman, A.; Laughlin, J. S. 1973.

In Biological and clinical dosimetry.

The tissue equivalent calorimetric dosimeter system has been designed to provide a primary calibration standard for the ionization chambers and other secondary dosimetric systems used to measure fast neutron dose. All major parts of the calorimeter have been constructed of Shonka A-150 plastic. Preliminary results are discussed. (WHK)

22737 (COO-3522-3, pp 16-17) DOSIMETRY FOR ^{252}Cf MEDICAL NEUTRON SOURCES. Anderson, L. L. 1973.

In Biological and clinical dosimetry.

Detailed dosimetry studies of ^{252}Cf have been conducted. Neutron and gamma ray absorbed dose distributions have been measured and preliminary estimates of the beta ray dose are discussed. Preliminary results of a series of rabbit testes irradiations are also given. (auth)

22738 (COO-3522-14) BIOLOGICAL AND CLINICAL DOSIMETRY. Progress Report, July 1, 1973–June 30, 1974. Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 31 Oct 1974. Contract AT(11-1)-3522. 72p. Dep. NTIS $6.75.

Separate abstracts were prepared for the five sections presented. (WHK)

For abstracts of individual sections see: 22685, 22739–22741, and 22955.

22739 (COO-3522-14, pp 6-13) DIRECT CALORIMETRIC MEASUREMENT OF ABSORBED DOSE. McDonald, J. C.; Canada, T. R.; Freeman, R.; Laughlin, J. S. 31 Oct 1974.

In biological and clinical dosimetry. Progress report, July 1, 1973–June 30, 1974.

The thermal defect, which occurs in plastics used for absorbed dose calorimeters, has been studied in detail for Shonka A-150 tissue equivalent (T.E.) plastic. A thermal excess of 10% is attributed to a failure to anneal dissolved oxygen. It has been found that thermal annealing results in an absorber whose output stabilizes quickly and remains constant with accumulated dose. Details of sample preparation and other physical measurements are discussed. (auth)

22740 (COO-3522-14, pp 14-28) NEUTRON DOSIMETRY. McDonald, J. C.; Canada, T. R.; Freeman, R.; Laughlin, J. S. 31 Oct 1974.

In biological and clinical dosimetry. Progress report, July 1, 1973–June 30, 1974.

A number of physical properties of the fast neutron fields produced when 8 MeV deuterons or 23 MeV ^3He ions are incident upon a thick beryllium target have been measured. These include: the angular distributions of total dose, the linear dose attenuation coefficients of steel, lead, and a polyethylene mixture, the dependence on depth of the neutron dose and the gamma-ray dose. The radiobiological properties of the $^9Be(^3He,n)$ and $^9Be(d,n)$ neutron fields have been studied as a function of depth within a water phantom. Aerobic HeLa S3 cell survival data were obtained at three depths between 2 and 12 cm. The resulting survival curves, plotted as a function of neutron dose, show no dependence on depth. Aerobic and hypoxic HeLa S3 cells were irradiated in-vitro at depths of 2 and 12 cm. Although the resulting survival curves show a small decrease in sensitivity with increasing depth, the oxygen enhancement ratio remains constant and has a value of 1.8 ± 0.1 in both fields. (auth)

22741 (COO-3522-14, pp 29-38) MICRODOSIMETRIC MEASUREMENTS. McDonald, J. C.; Canada, T. R.; Freed, B. R.; Laughlin, J. S. 31 Oct 1974.

In biological and clinical dosimetry. Progress report, July 1, 1973–June 30, 1974.

A commercially produced, 12.7 mm diameter, spherical proportional counter of the Rossi type was used to measure the spectral distribution of event size at various positions within the neutron fields in water phantoms. The wall of the chamber is constructed of T.E. plastic, 1.27 mm thick, and is enclosed in a 0.18 mm thick aluminum shield. The counter was filled with the T.E. gas to a pressure of 5.25 mm Hg, giving an effective diameter of 1.0 μm. The chamber was operated at a potential difference of 550 volts. Standard low noise electronics were used to amplify the counter signals which were analyzed and stored in a 256 channel multichannel analyzer. The analyzer is interfaced to an IBM 1800 computer making the data available for immediate analysis. The counter was calibrated with an internal ^{241}Am alpha source which gave a peak at 84.8 keV/μ. Results are presented and discussed. (WHK)

22742 A PROPORTIONAL COUNTER FOR THE MEASUREMENT OF ENERGY DEPOSITION DISTRIBUTIONS OF CHARGED PARTICLES. Berthoud, G.; Bull, S. R.; Giroux, J.; Herbaut, Y.; Smith, L. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service de Protection et des Etudes d'Environment). Nucl. Instrum. Methods; 121: No. 3, 483-489(1 Nov 1974).

A proportional counter was constructed to measure energy deposition frequency distributions of charged particle beams in tissue-equivalent gas. Site sizes down to 0.37 μm can be simulated. The operating characteristics and calibration of the counter, including a comparison with the Vavilov distribution, are described. (auth)

22743 SIGNAL STABILIZATION AND FADING IN RADIOPHOTOLUMINESCENCE GLASS DOSIMETERS AT VARYING SPECIFIC ENERGIES. Spanne, P. (Linkoepings Hoegskola, Sweden). Health Phys.; 27: No. 6, 589-592(Dec 1974).

An investigation of the stability of the signal measured by radiophotoluminescence glass rod dosimeters after irradiation with doses of 5×10^3 to 10^6 rad of low LET radiation is described. To find a suitable stabilization procedure a batch of dosimeters were irradiated with ^{137}Cs γ-rays in the prescribed dose range and then thermally treated for different times at 110°, 130° and 160°C. The results are presented. It is recommended that a thermal treatment at 110°C for 1.5 hr prior to read-out of radiophotoluminescence dosimeters is carried out for high dose measurements. To improve the dose determination, dosimeters which have received absorbed doses near the maximum of the calibration curve should be read out a second time in such a position that the exciting light has to pass through a different thickness of the dosimeter. The fading rate of the radiophotoluminescence signal is dependent not only on the LET of the radiation but also on the absorbed dose for low LET radiation. An increase in the fading rate after irradiation with low LET radiation is observed when the absorbed dose is increased. (UK)

22744 FADING OF PROTON RECOIL TRACKS IN NUCLEAR EMULSIONS. Knight, A. (National Radiological Protection Board, Sutton, Eng.). Health Phys.; 27: No. 6, 606-607(Dec 1974).

Criticism has been made of the use of nuclear emulsions for neutron personal monitoring due to the fading of proton recoil tracks in the emulsion over a period of time particularly in a moist atmosphere. At the National Radiological Protection Board the problem of fading has been reduced significantly by the use of moisture resistant packets. The method of preparation of the films is given. The effectiveness of the packets in reducing fading has been checked experimentally using Am-Be neutrons. It was found that the number of tracks fell approximately exponentially with time. In films not sealed in moisture resistant packs the number of tracks after 4 weeks is about 30% of the number counted immediately after the irradiation. The results confirm that fading is not a serious problem if the moisture resistant packets are used. (UK)

22745 MEASUREMENT OF IONIZING RADIATION FROM COLOR TELEVISION RECEIVERS BY THERMOLUMINESCENT DOSIMETERS. Wang, Y. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Health Phys.; 28: No. 1, 75-78(Jan 1975).

Low energy ionizing radiation emission (≈24 keV x-radiation) from color television receivers has been measured by means of thermoluminescent dosimeters $CaSO_4$:Dy and BeO. The former is very sensitive to low dose measurement while the latter is almost energy independent. Under normal working conditions, the exposure rates for various color television receivers commonly used in Taiwan varied from 0.001 to 0.255 mR/hr. (UK)

22746 AMPLIFICATION OF RECOIL PARTICLE TRACKS IN POLYMERS AND ITS APPLICATION IN FAST NEUTRON PERSONNEL DOSIMETRY. Sohrabi, M. (Georgia Inst. of Tech., Atlanta). Health Phys.; 27: No. 6, 598-600(Dec 1974).

Preliminary results on the amplification of fast-neutron-induced carbon, oxygen, nitrogen and alpha particle tracks in polymers based on the electrochemical etching technique are reported. The possible application of this technique in fast neutron personnel dosimetry is also reported. (UK)

22747 THERMOLUMINESCENT PROPERTIES OF NATURAL BARIUM SULFATE. Prokic, M. (Institut za Nuklearne Nauke Boris Kidric, Belgrade). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 545-549(Dec 1974).

The use of the naturally-occurring mineral barium sulfate (barite) as a thermoluminescence radiation dosimeter is considered. When used in concrete radiation shields it provides a means for estimating the γ-ray exposure following nuclear accidents. (auth)

22748 ENERGY RESPONSE OF TLD BADGES LOCATED ON PERSONNEL. Hankins, D. E. (Los Alamos Scientific Lab., NM). Health Phys.; 28: No. 1, 80-81(Jan 1975).

It is shown that the peaking of the energy response of a dosimeter although contrary to the generally accepted approach of a flat energy response can, for some purposes, be a more desirable characteristic. Using a LiF TLD positioned in the open window of a prototype TLD badge taped onto a 7.6 cm thick polyethylene phantom an energy response was obtained which was compared with that obtained with LiF TLD material in air. It is shown that the high TLD response obtained represents a better measure of the surface dose than the reading obtained from a survey meter. To simulate tissue, a 1 cm thick layer of lucite was placed over the TLD's and additional exposures were made to determine the 1 cm depth dose curve. An energy response curve was also obtained for a prototype TLD badge having a filter of 0.64 mm plastic plus 0.64 mm of aluminum 1 cm in diameter. There is reasonably good agreement between the energy response curves for the TLD's located at 1 cm depth in lucite and that obtained with the filtered portion of the TLD badge. It is thus seen that a dosimeter that has a flat energy dependence when located on a person would underestimate the actual dose delivered to the person. (UK)

22749 RESPONSE OF LiF TO 1.0–4.0 keV ELECTRONS. Barber, D. E.; Moore, R.; Hutchinson, T. (Univ. of Minnesota, Minneapolis). Health Phys.; 28: No. 1, 13-15(Jan 1975).

Extruded LiF chips were irradiated in a scanning electron microscope (SEM) with electron energies of 1.0, 2.0 or 4.0 keV. The LiF chips were irradiated at several electron currents to deliver doses over the range of 5 to 1200 krads. The average dose, $\bar{D}$, over the depth of electron penetration was determined in rads. The thermoluminescence produced by the electrons was compared with that produced by ^{137}Cs γ-rays. The sensitivity of the LiF to electrons was found to be 0.2 to 0.4 times its sensitivity to ^{137}Cs γ-rays. This indicates that thermoluminescence in LiF is produced with remarkable efficiency even at low electron energies provided the electrons reach the LiF. (auth)

22750 CONSISTENCY OF FERROUS SULPHATE-BENZONIC ACID-XYLENOL ORANGE DOSIMETER. Gupta, B. L.; Gomathy, K. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 509-513(Dec 1974).

The response of the dosimetric system containing 0.20 mM ferrous ammonium sulphate, 5.0 mM benzoic acid and 0.20 mM xylenol orange in 0.05 N sulphuric acid (FBX dosimeter) at low doses is not very susceptible to the variation in its composition. The dosimetric solutions could be stored for about 2 weeks before irradiation and up to 3 days after irradiation without any significant error in dose estimations. The paper gives a calibration curve for ^{60}Co radiation, and the response to 14.7 MeV neutrons, fission neutrons and recoils from $^{10}B(n,\alpha)^7Li$ reaction. The FBX dosimeter could be used for dosimetry of x, γ and neutrons in the range 0.1 to 3000 rad. (auth)

22751 OPERATIONAL IMPORTANCE OF RETRAPPING IN CaF_2:Mn DOSIMETERS. Lucas, A. C.; Kapsar, B. M. (Harshaw Chemical Co., Solon, OH). Health Phys.; 27: No. 6, 600-603(Dec 1974).

Glow curves of thermoluminescent CaF_2:Mn have been studied to investigate subtleties in the trapping mechanism which become important in obtaining the best possible performance from a dosimeter system based on this material. First, the glow maximum must be assumed to consist of either a multiplicity of traps or a band. Second, there is a small anomalous fade which is not explainable using any combination of non-interacting traps. Third, there is a small low temperature peak which may contribute a small percentage to the observed fading in some circumstances. Finally, some of the traps interact in a way which may cause one to infer an anomalous background drift rate. (UK)

22752 THERMOLUMINESCENT DOSIMETRY. I. Benko, I. (Izotop Intezete, Budapest). Izotoptechnika; 17: No. 12, 578-593 (Dec 1974). (In Hungarian).

The determination of γ-fields and personnel dosimetry by means of a Victoreen Model 2800 TLD system are discussed. (auth)

22753 INVESTIGATION OF THE AQUEOUS GLYCINE SOLUTION AS A GAMMA-RAY AND NEUTRON DOSIMETER. Tugsavul, A. (Cekmece Nuclear Research and Training Center, Istanbul). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 571-572(Dec 1974).

The use of glycine solution as a neutron and γ-ray dosimeter has been investigated. Evaluation of the response under different conditions showed that 0.1 M glycine and 0.002 N sulfuric acid gave best results in the dosimeter system. 0.002 N sulfuric acid was added to the glycine solution to adjust to a pH = 4.0. It was found that this dosimeter can be used not only for the dosimetry of neutron and gamma radiations but also to measure the neutron flux within certain limits. For use as a chemical dosimeter it has several advantages, it can be prepared from readily available chemicals and it is insensitive to many common impurities, it has a long storage life under normal laboratory conditions and the glycine system is independent of such other parameters as the presence or absence of oxygen or vacuum. Changes in the temperature between 10° and 40° does not effect the deamination of glycine. The system is applicable to dose measurements in the range of 1×10^5 to 2×10^8 rads. (UK)

22754 p-n JUNCTION CUPROUS OXIDE DIFFERENTIAL DOSIMETER FOR γ-RADIATION. Sugier, H.; Mazurek, L. (Univ. of Lodz, Poland). Radiochem. Radioanal. Lett.; 20: No. 3, 183-190(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

The p-n junction cuprous oxide differential dosimeter for γ-radiation was investigated. Its dosimetric characteristics and the stability towards radiation damage proved to be satisfactory. (auth)

22755 COMPARATIVE INVESTIGATIONS OF CHARACTERISTICS OF VARIOUS TL DOSIMETERS. Niewiadomski, T.; Jasinska, M.; Ryba, E. (Inst. of Nuclear Physics, Krakow). Nukleonika; 18: No. 11, 31-44(1973).

In order to study the possibility of using various TL dosimeters and phosphors for comparisons of dosimetric data of different irradiation facilities, several types of commercially available LiF : Mg,Ti materials were investigated with regard to their dosimetric behavior within the exposure range 50 to 1000 R. It was found that all the materials exhibit qualitatively common properties, with some quantitative differences in glow curve shape and luminescence yield arising when changing the radiation energy and increasing the dose. The differences also depend on readout conditions, hence, if high measurement accuracy is to be achieved, no dose response data found in literature could be used: the behavior of the actually used and correctly annealed material batch must be measured exactly for those exposure and read-out conditions in which the dosimeters are used. The appropriate calibration procedure and use of some control dosimeters (which are capable of detecting uncontrolled changes in dosimetric characteristics) together with the measuring ones allow the measurement errors to be reduced to a value of 1 to 2% SD, not only in laboratory conditions but also during the real measurements. (auth)

22756 INSTRUMENT FOR THE RAPID CHECK OF OUTPUT, ENERGY, AND FIELD SYMMETRY OF SUPERVOLTAGE THERAPY EQUIPMENT. Jones, D.; Schumacher, D. (Univ. of Washington, Seattle). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 198-202(Jan 1975).

A monitor for measuring the output, energy, and symmetry of therapeutic x-ray sources such as linac sources is described. The monitor is composed of two silicon diode detectors arranged in a wood block. (WHK)

22757 INSTANTANEOUS DISPLAY LINEAR ACCELERATOR FIELD FLATNESS MONITOR. Haskard, D. L. (Univ. of Adelaide). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 192-197(Jan 1975).

A beam flatness monitor is described which consists of 16 ion chambers and amplifiers, the outputs of which are sequentially sampled and displayed as a series of dots or lines on a conventional cathode ray oscilloscope, giving an instantaneous display of beam flatness variations. The device is used routinely for checking the beam flatness of our linacs. (auth)

22758 ANALOG-DIGITAL CURRENT–FREQUENCY CONVERTER WITH SIX DECIMAL PLACES. Kudryashov, V. F.; Shaks, A. I. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1015-1017(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 72-73(1974).

An analog-digital current–frequency converter is described which allows measurement of the current in the range from 3×10^{-11} to 3×10^{-6} A without switching the subranges. The pulse-current response has a nonlinearity not exceeding 2% in the range from 3×10^{-10} to 3×10^{-6} A, and not exceeding 6% in the range from 3×10^{-11} to 3×10^{-10} A. In the temperature range from −8 to +45°C the counting rate is constant within 3%. The circuit is implemented using two 1UT 401A integrated microcircuits and four transistors. The analog-digital conversion is used to record the current from a photoelectron multiplier in an experimental thermoluminescent batching unit. (auth)

22759 ON THE APPLICATION OF ORGANIC SCINTILLATORS FOR DETERMINING THE DOSE EQUIVALENT IN MIXED RADIATION FIELDS. Pszona, S. (Institute of Nuclear Research, Warsaw (Poland)). Postepy Fiz. Med.; 8: 47-50(1973). (In Polish).

From third symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Results are presented of the work at the Radiation Protection Department of the Institute of Nuclear Research on the application of organic scintillators for determining the dose equivalent and quality factor of radiation. Results obtained with the pulse and the averaging methods are discussed. (auth)

22760 THE THERMOLUMINESCENCE DIFFERENCES IN FRENCH AND U. S. PRODUCED LITHIUM FLUORIDES FOR DOSIMETRY. Balcerzak, Cz. (Akademia Medyczna, Lodz (Poland)). Postepy Fiz. Med.; 8: 39-45(1973). (In Polish).

From third symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Results are discussed of the comparative investigations on lithium fluoride, made at the Atomic Energy Center in Fonteney aux Roses (France). The equipment and measuring techniques are described, and results are presented for LiF produced by Harshaw, type TLD-100 (USA) and for LiF produced in France (type PTL). Lithium fluoride with sodium or magnesium admixtures was found to give the dosimetric maximum which is more stable in time. (auth)

22761 SOME PROPERTIES OF THERMOLUMINESCENT MATERIALS PRODUCED IN FRANCE FOR LOW AND HIGH DOSE MEASUREMENTS. Balcerzak, Cz. (Akademia Medyczna, Krakow (Poland)). Postepy Fiz. Med.; 8: 201-211(1973). (In Polish).

The paper discusses dosimetrie properties of some thermoluminescent materials produced in France. Results of the studies on the range and the accuracy of the dose measurements with the aid of these materials are given. Various applications for the materials in dosimetry are also discussed. (auth)

22762 EXPLORATORY DEVELOPMENT OF THE SYSTEMS FOR REACTOR TECHNOLOGICAL DOSIMETRY. Kovaleva, E. P.; Petryaev, E. P.; Kalyazin, E. P. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 16-20(1973). (In Russian).

Features are considered in the dosimetry of mixed, gamma-neutron, reactor radiation used to irradiate various liquids in industrial processes. Results are presented in an investigation of the radiolysis of methanol, ethanol and their aqueous solutions as a function of absorbed dose, dose rate, and irradiation temperature. The radiolysis of aqueous alcohol solutions is carried out under dynamic conditions. It is shown that aqueous solutions of methanol and ethanol at 3 molar concentration in recording the radiation effect from ethyleneglycol in the case of methanol system and from 2,3-butanediol in the case of ethanol systems can be recommended for determining the total absorbed dose while carrying out the dosimetry under high-temperature, large-scale radiation conditions in a reactor loop. (tr-auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 24234.

22763 A RANDOMIZATION PROCEDURE WITH APPLICATIONS TO MOESSBAUER SPECTROSCOPY. Agresti, D. G.; Belton, M. L. (Alabama Univ., Birmingham (USA)). Nucl. Instrum. Methods; 121: No. 2, 407-410(15 Oct 1974).

A procedure (YTEST subroutine) for producing artificial data is described and applied to several illustrative situations relevant to Moessbauer spectroscopy, including determining bias and optimizing experimental conditions. Theoretical curves for the width, Γ exp, and resonance effect, ϵ, of a Lorentzian fitted to thick-absorber transmission spectra are presented for several values of the ratio of the width, Γ_a, of the absorption spectrum to the source width, Γ_s. A listing of a Fortran IV subroutine for randomizing a theoretical spectrum is included. (auth)

22764 A MEASUREMENT METHOD OF TIME-OF-FLIGHT OF CHARGED PARTICLES. Andrade, E.; Alvarez, I.; Cisneros de Alvarez, C. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). Nucl. Instrum. Methods; 121: No. 2, 359-363(15 Oct 1974).

A simple method of measuring the time of flight of charged particles using an alpha particle source, a solid-state detector (SSD) and a channel electron multiplier (CM) is described. The charged particle to be analyzed passes a thin foil, setting free electrons that are accelerated and detected by the CM; and its output provides a reference time signal. The second time signal and energy information of the charged particle are obtained from the SSD at the end of the flight path. Test measurements and the performance of the time-of-flight spectra are described. The method may be used as an energy-time-of-flight technique for mass identification of charged particles from nuclear reactions induced by target bombardment with direct current beam. (auth)

22765 SPECTROMETRY OF NEUTRONS PRODUCED IN THE REACTIONS (p,n), (d,n) AND (^{3}He,n) NEAR THE VAN DE GRAAFF TANDEM ACCELERATOR OF THE CENTRE D'ETUDES DE BRUYERES-LE-CHATEL. Adam, A.; Cabe, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Nucl. Instrum. Methods; 121: No. 2, 339-351(15 Oct 1974). (In French).

A multi-detector time-of-flight system for fast neutron detection is presented. This system has been developed to be used with charged-particle induced reactions at the "Neutron Hall" of the tandem Van de Graaff facility of the Centre d'Etudes de Bruyeres-le-Chatel. Special attention has been given to collimator design and absolute measurements of neutron detection efficiency. Details of the pulse shape discrimination methods and data handling systems are also presented. Results of the entire system are illustrated by several neutron spectra obtained from (p,n), (d,n) and (^{3}He,n) reactions. (auth)

22766 A TWO METER CURVED-CRYSTAL SPECTROMETER WITH IMPROVED EFFICIENCY FOR USE AT LAMPF. Henrikson, H. E.; Boehm, F. (California Inst. of Tech., Pasadena (USA)). Nucl. Instrum. Methods; 121: No. 2, 269-273(15 Oct 1974).

A high resolution, 2 m radius, curved-crystal gamma-ray spectrometer has been constructed to be used at the Los Alamos Meson Physics Facility. An increase in luminosity is achieved with a long, adjustable, curved, resolving slit system. The curved slit eliminates the error due to vertical divergence. A segmented high purity germanium detector is used. The curved crystal pivot, sine mechanism, and slit assembly are mounted on a prestressed concrete seismic mass pneumatically isolated from the floor. Data are presented on the operation, resolution, and efficiency of the spectrometer. (auth)

22767 DESIGN OF AN ELECTRON TRANSMISSION SPECTROMETER USING A TRIAL-AND-ERROR TECHNIQUE. Porter, H. Q.; Walker, I. C. (Stirling Univ., Scotland). Int. J. Mass Spectrom. Ion Phys.; 15: No. 1, 67-77(Sep 1974).

Some basic electron optics and computational techniques useful in electron optical design are reviewed and applied to the design of a constant-background electron transmission spectrometer. (auth)

22768 PORTABLE RADIOACTIVITY MONITOR FOR LIQUID EFFLUENTS, SURFACE CONTAMINATIONS, AND BULK SOLID WASTES. Umbarger, C. J.; Cowder, L. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Instrum. Methods; 121: No. 3, 491-498(1 Nov 1974).

A versatile monitoring system is described which allows the nondestructive analysis of batch liquid samples, surface contaminations, and bulk waste packages for radioactive materials. The system uses the simplicity and extremely high sensitivity of NaI-based gamma-ray spectroscopy. As an example of the instrument's versatility, the simultaneous measurement of ^{235}U, ^{238}U, and thorium in liquids at sub-MPC (maximum permissible concentration) levels is described in detail. As a further demonstration of the system's capabilities, the assay of solid transuranic wastes at 10 nCi/g levels is discussed. (auth)

22769 MULTIPARAMETER PULSE-HEIGHT ANALYSIS WITH A PDP-8/E COMPUTER. Kendrick, N. S. Jr.; McClure, D. A. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). Nucl. Instrum. Methods; 121: No. 3, 573-580(1 Nov 1974).

A γ-ray spectrometer has been constructed based on the use of a PDP-8/e computer. The system operates in the singles or coincidence pulse-height analysis mode from one, two or three analog-to-digital converters (ADC). Any one of the ADC outputs can be stored separately or any two can be stored simultaneously in the so called dual-singles storage mode. The interface also allows the storage of two- or three parameter coincidence data the output of which is recorded event-by-event on industry compatible magnetic tape. Input to the computer is made via an external patch panel connection which allows total flexibility in the selection of data formating to magnetic tape. A simple circuit has been developed to allow the PDP-8/e to be held at memory cycle time TP4 so that the rather restrictive timing requirements of the processor can be easily met. The circuit often allows the saving of a complete memory cycle period (~1.4 μs) by delaying the processor at TP4 by only a few nanoseconds. (auth)

22770 A SIMPLE DEAD-TIME STABILIZER FOR GAMMA-RAY SPECTROMETERS. de Bruin, M.; Then, S. S.; Bode, P.; Korthoven, P. J. M. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Nucl. Instrum. Methods; 121: No. 3, 611-613 (1 Nov 1974).

The dead-time stabilizer described is based on the use of a pulse generator with variable frequency. The pulses from the pulse generator are fed into the input of the γ-ray spectrometer and the frequency is controlled by the dead-time signal from the

ADC in such a way that the system dead-time is kept constant and independent of the detector counting rate. (auth)

22771 SINUSOIDAL MODULATION FOR A NEUTRON FOURIER TOF SPECTROMETER. McCarthy, J. P. Jr.; Danner, H. R. (Missouri Univ., Columbia (USA)). Nucl. Instrum. Methods; 121: No. 3, 609-610(1 Nov 1974).

Periodic modulation in neutron time-of-flight spectroscopy is usually achieved using a rotor and stator with identical radial window patterns; such an arrangement produces triangular modulation which contains contributions from the higher odd harmonics. If phase-sensitive detection with four quarter-period scalars is employed, it is possible to correct partially for the presence of the higher harmonics using high frequency data; to eliminate the third harmonic completely requires seven unequal or twelve equal counting channels. In either case one is left with a systematic error of unknown influence. In order to avoid these complications, the modulation of the Fourier spectrometer at the Missouri University Research Reactor has been converted from triangular to sinusoidal by reshaping the stator windows. (auth)

22772 A POSITION-SENSITIVE PROPORTIONAL COUNTER FOR MAGNETIC SPECTROGRAPHS WITH A BENT FOCAL PLANE. Cleemann, L.; Schimmer, B.; Lauterjung, K. H. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 121: No. 3, 605-607(1 Nov 1974).

A position-sensitive proportional counter, the counting wire of which carries a small direct current, can be adapted to bent focal planes with the help of a weak external magnetic field. (auth)

22773 GAMMA RAY APPARATUS WITH SAMPLE CHANGER. Luitwieler, S. H. Jr.; Klein, P. R.; Robinson, D. D. (to Beckman Instruments, Inc.). US Patent 3,859,528. 7 Jan 1975. Filed date 26 Mar 1973. 8p.

A gamma ray measuring apparatus having a multicompartment sample holder incrementally advanced along the surface to a measuring station is described. The sample holder contains a plurality of sample containing vials in close mating relationship within the compartments, each compartment being provided with an aperture in the bottom thereof, the aperture being of smaller dimension than the cross-sectional dimension of the vial. A detector assembly at the measuring station has an elongated access port therein, the lower portion of the access port having a funnel-shaped entrance end with the upper portion thereof having a crystal detector in proximity thereto. An elevating rod passes through the aperture engaging the bottom surface of the vial to raise the vial guided by the compartment and the funnel-shaped entrance through the access port into the sample chamber adjacent the crystal detector for sample measurement. The elevating rod is made of a shielding material for shielding the crystal detector from rays emanating from samples within the sample holder. Provision is made for access to the well by means of a manual sample access port in alignment with the upper portion of the well. The port is plugged during operation of the apparatus in the automatic mode, and a special vial holder is provided for access to the well in a manual mode. (Official Gazette)

22774 GAMMA RAY SPECTROMETER DISPLAY MEANS. Luitwieler, S. H. Jr.; Klein, P. R. (to Beckman Instruments, Inc.). US Patent 3,860,823. 14 Jan 1975. Filed date 26 Mar 1973. 8p.

A gamma ray spectrometer is described having a plurality of presettable channels, a given channel being selectable for displaying on a cathode ray tube a trace proportional to the energy of the gamma ray of a given sample and the intensity of the given energy event. The cathode ray tube is originally biased so that the beam is below the face of the tube and therefore not displayed. A sweep gate signal for the cathode ray tube is driven by the selected channel for deflecting the beam onto the face of the tube and for selectively blanking and unblanking the cathode ray tube in response to the sweep gate signal for displaying on the cathode ray tube only that trace indicative of the selected channel, the height of the trace on the tube being indicative of the energy while the intensity of the trace so displayed is proportional to the count rate. (Official Gazette)

22775 NUCLEAR SPECTROSCOPY AND REACTIONS. Part A. Cerny, J. (ed.). Pure and Applied Physics, Volume 40-A. New York; Academic Press, Inc. (1974). 535p.

Separate abstracts were prepared for the 14 sections included. (WHK)

For abstracts of individual sections see: 22716, 22776–22778, 22844, 22859, 23448–23451, 23469, and 23498–23500.

22776 LARGE NaI DETECTORS. Paul, P. (State Univ. of New York, Stony Brook). pp 345-364 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The fabrication and performance of NaI scintillation detectors for gamma spectroscopy at 10 to 40 MeV are discussed. The design and resolution of NaI detectors with anticoincidence shields and performance for cosmic ray background rejection are described. Electronic circuitry for use with NaI detectors for use in high count rates is discussed. Circuits for pulse pileup rejection, anticoincidence circuits, and gain stabilization electronics are considered. A few selected examples of the applications of NaI detectors are discussed to give an impression of the kind of experimental conditions for which these γ detectors are suited. (WHK)

22777 MAGNETIC DETECTION OF CHARGED PARTICLES. Hendrie, D. L. (Univ. of California, Berkeley). pp 365-412 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

An introduction to magnetic spectrometer equipment for studying nuclear reaction products is presented. The prerequisite beam transport formalism is described; examples of several spectrometer types are given; and the conditions for the various dispersion and kinematic compensations of which a well-designed spectrometer system is capable are reviewed. Also, the types of detectors for particle detection at the focal plane of magnetic spectrometers are reviewed. (WHK)

22778 SEMICONDUCTOR DETECTOR SPECTROMETER ELECTRONICS. Goulding, F. S.; Landis, D. A. (Univ. of California, Berkeley). pp 413-481 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Basic considerations in energy measurements including statistical effects in detectors, noise reduction, the input circuit and preamplifier, effects of fluctuations in detector signal rise time, and degradation factors of high counting rates are discussed. Also, design factors in electronic modules for spectroscopy, basic considerations in time measurements, and design factors in electronic modules for fast timing are reviewed. (WHK)

22779 MULTIDIMENSIONAL GAMMA–RAY SPECTROMETER WITH A LIQUID–SCINTILLATION–COUNTER ANTICOINCIDENCE RING. Grismore, R.; Barbee, A.W. Jr.; Berry, M.L.; Taboas, A.L.; Emmons, D.R. (Department of Physics, Indiana State University, Terre Haute, Indiana 47809). Rev. Sci. Instrum. 46: No. 3, 243-245 (Mar 1975).

Details are given of a NaI(Tl) multidimensional gamma–ray spectrometer employing a low–cost liquid–scintillation–counter anticoincidence ring which has been constructed at Indiana State University. Data are presented on the background counting rates of this spectrometer both with and without the anticoincidence ring operating, and comparisons are made with the background of a very similar spectrometer employing a NaI(Tl) anticoincidence ring. The liquid–scintillator anticoincidence ring is shown to be effective, and capable of improvement so as to bring the background of the spectrometer down to nearly the same level as with a NaI(Tl) ring. (auth)

22780 GAMMA–RAY SPECTROSCOPY WITH SINGLE–CARRIER COLLECTION IN HIGH–RESISTIVITY SEMICONDUCTORS. Malm, H.L.; Canali, C.; Mayer, J.W.; Nicolet, M. (California Institute of Technology, Pasadena, California 91125); Zanio, K.R.; Akutagawa, W. Appl. Phys. Lett. 26: No. 6, 344-346 (15 Mar 1975).

With the standard plane–parallel configuration of semiconductor detectors, good γ–ray spectra can only be obtained when both electrons and holes are completely collected. We show by calculations (and experiments) that with contacts of hemispherical configuration one can obtain γ–ray spectra of adequate resolution and with signal heights of nearly full amplitude even when only one type of carrier is collected. Experiments with CdTe detectors for which the $\mu\tau$ product for electrons is about 10^3 times that of the holes confirm these calculations. The adoption of hemispherical contacts thus widens the range of high–resistivity semiconductors potentially acceptable for γ–ray detection at room temperature. (auth)

22781 UTILIZATION OF INFORMATION-COMPRESSION METHODS IN EXPERIMENTS ON GAMMA–GAMMA COINCIDENCES. Gromov, K. Ya.; Zaidler, Z.; Ormandzhiev, S. I.; Fominykh, V. I.; Fominykh, M. I.; Tsupko-Sitnikov, V. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1006-1010(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 64-68(1974).

The conduct of an experiment on γ–γ coincidences based on an electronic computer with recording of complete information having a large volume ($\sim 10^6$ channels) in compressed form ($\sim 5 \cdot 10^3$ channels) is described. Information on coincidences is recorded in a magnetic on-line memory (of a Minsk-2 computer) in the form of several (2-3) one-dimensional spectra obtained as a

result: of functional transformations of the parameters of each two-dimensional event and allows the necessary qualitative and quantitative analysis with cascade transmissions to be performed. (auth)

22782 ADJUSTABLE MONOCHROMATOR IN A NEUTRON SPECTROMETER. Gross, Ya. G.; Okuneva, N. M. (Inst. of Physics and Tech., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 996-997(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 56-67(1974).

The layout and computation of an adjustable monochromator in a neutral spectrometer are described. The distinguishing feature of the monochromator lies in the fact that a monoenergetic neutron beam reflected from the crystal-monochromator is always directed onto a fixed sample throughout the entire range of rotation angles. This is achieved by displacing the crystal simultaneously with its rotation. The total rotation angle is 70° (from 10 to 80°). (auth)

22783 EVALUATION OF COLLIMATOR OF ECIL'S MEDICAL SPECTROMETER MDS-26 FOR THYROID UPTAKE MEASUREMENTS. Mehta, S. C.; Jain, S. C. (Institute of Nuclear Medicine and Allied Sciences, Delhi (India)). Indian J. Radiol.; 27: No. 1, 39-42(Feb 1973).

Studies were carried out on the response of the detector-collimator systems of ECIL's medical spectrometers MDS-26 to a point source of ^{131}I. Sensitivity and spatial response were studied using the 0.364 and 0.640 MeV photopeaks as well as integral counting. Results are compared with the specifications laid down by IAEA for thyroid uptake measurements. (auth)

22784 AUTOMATED TECHNIQUE OF PLOTTING COUNTING DIAGRAM FOR NEUTRON LOGGING- AND NEUTRON-GAMMA LOGGING CHANNELS. Bulgakov, R. B. Razved. Geofiz.; No. 59, 124-127(1973). (In Russian).

A method is described for calibrating gamma- and neutron-gamma equipment in radioactive borehole surveying by continuously counting a moving standard source. Rates of source movement and advantages of the method of taking the counting characteristics of the radioactive survey equipment are justified. (tr-INIS)

High Energy Physics Instrumentation

Refer also to abstract 23958.

22785 (CONF-730580-, pp 173-184) SPARK CHAMBER OPERATION IN HIGH MAGNETIC FIELDS. 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The lateral displacement phenomenon of the spark and the increase of memory time due to the combined action of the clearing and magnetic fields for spark chamber operation in high magnetic fields were studied. An additional effect is a displacement of the spark due to the HV pulse field. In the polarization experiment, recently performed by the CERN-Trieste Group, a small cylindrical spark chamber was operated in the magnetic field of the polarized proton target magnet. The field in the volume of the spark chamber was of 2.5 T (the maximum value of B at which a spark chamber has been operated as yet is 1.6 T). Some measurements on the operation of the spark chamber in the magnetic field, both for determining experimentally some parameters of relevance to the experiment, like the clearing field requested for a given memory time, and the corresponding lateral displacement of the spark, and for checking the validity of formulas for electron drift at such high magnetic fields are reported. (WHK)

22786 (CONF-730580-, pp 185-189) COMPUTER-CONTROLLED FAST DECISION LOGIC. Pregernig, L. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

A decision logic system for an array of 80 scintillation detectors for triggering a spark chamber is described. (WHK)

22787 (CONF-730580-, pp 191-210) STRIP LINES FOR READ-OUT OF MULTIWIRE PROPORTIONAL CHAMBERS. 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The application of a strip line for readout of multiwire proportional chambers is described and the performances are discussed in view of possible developments. (WHK)

22788 (IFVE-SPK/SVM-74-16) SPECIFICS OF TRACK-FOLLOWING AND MEASUREMENTS IN THE AGREEMENT SIGNAL ANALYSIS MODE. Anikeev, V. B.; Zhigunov, V. P.; Kryutchenko, E. V.; Kuchin, Yu. M.; Nikitin, S. G.; Sokolov, S. N.; Utochkin, B. A.; Khamaza, A. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The tracks in the pictures from the Mirabelle bubble chamber were followed and measured in the new mode of a CRT device that uses an analysis of the "agreement" signal. In the case of good prognosis, it was found possible to follow tracks of a very low contrast when a track is almost indistinguishable by the human eye. Side tracks intersecting with the followed one at angle larger than 1° do not create any difficulty for the track-following. The master-points measured on the track do not deviate from the interpolating curve farther than 5 microns. (auth)

22789 (JINR-13-7683) FACILITY FOR INVESTIGATION OF THE PION BACK ELECTROPRODUCTION REACTION $\pi^- + p \rightarrow e^+ + e^- + n$. Demyanov, A. V.; Kuptsov, A. V.; Kurochkin, V. P.; Nemenov, L. L.; Sidorova, V. I.; Smirnov, G. I.; Trifonov, V. L.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 14p. (In Russian). INIS.

A description is given of an experimental unit intended to investigate the reaction $\pi^- + p \rightarrow e^+ + e^- + n$ at pion energies of 270 MeV. The electrons and positron from the reaction are recorded by two telescopes consisting of optical, wide-gap spark chambers, scintillation and Cherenkov counters, and full-absorption, Cherenkov spectrometers. The parameters of the recorded events were measured by a sixteen-fold analysis system on line with a "Minsk-22" computer. The photofilm from the spark chambers was treated by means of an automatic processing unit on an electron-beam tube LELT-1. (tr-SJR).

22790 (JINR—P13-8367) SPECTROMETER TRIGGERING SYSTEM AND EXPERIMENT ON π-e SCATTERING AT ENERGY OF 50 GeV. Adylov, G. T.; Aliev, F. K.; Vodop'yanov, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The speed of data taking and data quality in the π^--e scattering experiment at 50 GeV to a great extent depend on the operation quality of the triggering system of the spectrometer. It consists of scintillation counters, two lead glass Cherenkov spectrometers and a corresponding system of fast electronic logic. The main elements of the triggering system are described. Their parameters are given which permit a high detection efficiency of scattering events to be obtained at a sufficiently large coefficient of suppression of background events. (auth)

22791 (KHFTI-74-5) SIMULATION OF THE TRACKS IN BUBBLE AND DIFFUSION CHAMBERS. Vaisfel'd, A. M.; Koltunov, I. A.; Lyubarskii, G. Ya. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The algorithms and instructions for utilization of five programs of the general name "simulation of chamber experiment" are described. They examine the simulation of heavy particle tracks in bubble chambers and diffusion chambers with all physical effects (ionization losses, multiple scattering, measuring errors, film contraction, etc.). (auth)

22792 WIDE RANGE MULTI-CHANNEL ANALOG SWITCH. Levit, L. B.; Humphreys, D. R.; Porter, L. G. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). Nucl. Instrum. Methods; 121: No. 3, 505-508(1 Nov 1974).

A ten-channel analog switch has been developed as a sample and shape circuit for signals used as inputs to a logarithmic pulse height recording system for a large ionization spectrometer for cosmic ray studies. The circuit employs a field effect transistor as the switching element. Switching transients are reduced to approximately 2 mV by adding to the gated signal an inverted transient generated by an identical circuit with no signal applied. The circuit is linear to 2% from 3 mV to 10 V. (auth)

22793 THE CHARACTERISTICS OF CURRENT-LIMITED SPARK CHAMBERS. Bull, R. M.; Youle, J. H. (Nottingham Univ. (UK)). Nucl. Instrum. Methods; 121: No. 2, 259-268(15 Oct 1974).

The characteristics of current-limited spark chambers are discussed with emphasis on their practical application as nuclear particle detectors. The work is characterized by its investigation of a wide variety of chambers and discusses their design at some length. Data on the operating parameters (such as the high voltage

pulse characteristics) are provided for chambers of different dimensions. Finally the performance of these chambers is analyzed in terms of such factors as locational accuracy and multiple efficiency. (auth)

22794 CHARACTERISTICS OF A DETECTOR HAVING A TRANSITION-RADIATION RADIATOR IN THE PROPORTIONAL COUNTER AT AN ELECTRON ENERGY OF 40 GeV. Alikhanyan, A. I.; Kankanyan, S. A.; Oganesyan, A. G.; Tamanyan, A. G. (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 990-991(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 51-52(1974).

The characteristics of a detector having a transition-radiation radiator (t.r.r.) have been investigated by means of a xenon proportional counter at an electron energy of 40 GeV. The characteristics of t.r.r. detectors with lamellar and foamplast radiation generators are compared. (auth)

Radiometric Instruments

Refer also to abstracts 22654–22656.

22795 (AD-782909) NONDESTRUCTIVE TESTING FOR MOISTURE CONTENT IN FOODS BY NEUTRON GAUGING. Technical Report. Helf, S. (Picatinny Arsenal, Dover, N. J. (USA)). Jun 1974. 36p. (PA-TR-4698). NTIS $3.25.

The application of neutron gauging to test for moisture content in bulk powdered foods and in canned army field rations is described. A small ^{252}Cf capsule, of approximately 10,000,000 n/s output, was used as a source. A brief discussion is presented on the basic principles of neutron interactions as relevant to moisture measurement and some background material is included on radioisotopic neutron sources. (auth)

22796 (AD-786565) NUCLEAR HELICOPTER AIR DENSITY INDICATING SYSTEM FLIGHT TEST PROGRAM. Blincow, D. W. (Tyco Labs., Inc., Pomona, Calif. (USA). General Nucleonics Div.). May 1974. Contract DAAJ02-73-C-0015. 69p. (ER-9016; USAAMRDL-TR-74-19). NTIS $4.25.

The design, construction, and testing of the nuclear helicopter air density indicating (NUHADI) system are discussed. The NUHADI measures the scattering of x-rays, generated by an isotopic source, from the air volume outside the helicopter. The number of x-rays backscattered into the detector is proportional to the number of molecules per unit volume, i.e., the air density. The air scatter signal is compared to an internal signal, from the same source, during each cycle to provide a continuous self-calibration. (auth)

22797 (AD-787130) ADVANCED CONCEPTS AND TECHNIQUES IN THE STUDY OF SNOW AND ICE RESOURCES. Library of Congress Catalog Card No. 74-10120. Santeford, H.; Smith, J. (National Academy of Sciences, National Research Council, Washington, D. C. (USA)). Jul 1974. 785p. NTIS $11.00.

The volume's purpose is threefold: to foster expanded and continuing cooperation among the various people working in the snow and ice field; to alert these people to the potential impact of new technological advances on the study and management of snow and ice resources; and to acquaint people working in related fields with the problems and complexities of the snow and ice medium. Major topic headings are: information needs and distinguishing characteristics, information systems, radar techniques, remote sensing techniques, nuclear techniques, and miscellaneous techniques. (GRA)

22798 REPRODUCIBILITY OF PROTON-INDUCED ELEMENTAL ANALYSIS IN BIOLOGICAL TISSUE SECTIONS. Kubo, H. (Department of Radiology, Kitasato University, Sagomihara, Kanagawa, Japan 228). Nucl. Instrum. Methods; 121: No. 3, 541-545(1 Nov 1974).

The reproducibility of trace element concentrations in biological tissue sections has been studied by a proton-induced X-ray fluorescence technique. With the use of beam defocusing and improved target preparations, a precision of ±20% was achieved. Applications for the simultaneous determinations of trace element concentrations in human tissues are demonstrated. (auth)

22799 A NEW METHOD OF THIN-FILM THICKNESS MEASUREMENT USING RADIOISOTOPE AUGER ELECTRONS. Mori, C.; Koike, J.; Watanabe, T. (Nagoya Univ. (Japan). Faculty of Engineering). Nucl. Instrum. Methods; 121: No. 2, 253-258 (15 Oct 1974).

A new, simple and comparatively precise method is proposed for the measurement of thin films of the order of a few $\mu g/cm^2$, which is based on the absorption of Mn K-Auger electrons emitted from ^{55}Fe. Since this method gives the relative thickness, standard samples of independently known thickness are necessary to obtain absolute values. The apparatus consists essentially of a GM counter and an ^{55}Fe source, situated on either side of a diaphragm which has a small aperture over which the specimen is set, and four holes for the flow of Q gas (He 99%, isobutane 1%) as counting gas. It takes 30 min per measurement including installation of the specimen and gas exchange. Vinyl or collodion films of 10 $\mu g/cm^2$ mass per unit area can be measured with 11% error. (auth)

22800 DUAL FUNCTION LOGGING TOOL AND METHOD. Kampfer, J. G. (to Halliburton Co.). US Patent 3,862,417. 21 Jan 1975. Filed date 23 Jul 1973. 8p.

A method and apparatus are described for converting a single function, i.e., hydrocarbon detection, well logging tool to a dual function tool, i.e., the detection of naturally occurring gamma rays, by making the amplitude reference pulses necessary for single function operation related in rate to the second function. A minimum constant rate of amplitude reference pulses are provided to ensure the operability of the single function tool in the absence of the second function and an adjustment is thereafter made to remove the effects of this minimum rate of reference pulses. (Official Gazette)

22801 WELL-LOGGING MEASURING APPARATUS AND METHOD. Moore, D. C.; Tittman, J. (to Schlumberger Technology Corp.). US Patent 3,858,037. 31 Dec 1974. Filed date 18 Jan 1973. 10p.

A specific embodiment of the invention provides a technique for identifying the mineral composition of an earth formation masked by a barite mudcake. The gamma radiation intensities on both sides of the K absorption limit for the barium in the mudcake are contracted with a normalized gamma radiation spectrum of the formation. The contrast indicates the nature of the mineral composition and some characteristics of the mudcake. (Official Gazette)

22802 INELASTIC NEUTRON SCATTERING METHODS TO LOCATE COAL AND OIL SHALE ZONES. McKinlay, P. F.; Smith, H. D. Jr.; Schultz, W. E. (to Texaco Inc.). US Patent 3,849,646. 19 Nov 1974. Filed date 5 Jun 1973. 10p.

A pulsed source of high energy neutrons is used to irradiate the earth formations in the vicinity of a well borehole. Gamma rays produced by the inelastic scattering of the fast neutrons are observed in four energy regions of the gamma ray energy spectrum corresponding to the inelastic scattering of neutrons by carbon, oxygen, silicon and calcium. Signals representative of the carbon/oxygen, calcium/silicon and carbon plus oxygen gamma rays observed are developed. By appropriately combining these signals with a gamma ray density log, spontaneous potential log or resistivity log the quality of coal bearing formations or oil shale regions penetrated by the borehole may be determined. (Official Gazette)

22803 MEASUREMENT OF LOCAL DENSITY BY GAMMA RAY ATTENUATION IN A FREE SURFACE FLASH EVAPORATOR. Coogan, C. H. Jr.; Giger, W. Jr.; Steigert, F. E. Paper No. 74-WA/PID-5. New York; American Society of Mechanical Engineers (1974). 8p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Measurement of local density using gamma ray attenuation throughout the stage of a small-scale model of a free surface fresh water flash evaporator is reported together with measured temperatures and velocities. The basic flow with evaporation is compared for one flow condition with non-evaporative flow. Substantial entrainment and recirculation was observed. Entrainment of vapor or gas in the hydraulic jump is reported. High vapor production regions are identified. (auth)

22804 METHOD AND APPARATUS FOR AUTOMATIC CORRECTION OF MEASURED THERMAL NEUTRON DECAY TIME. Nelligan, W. B. (to Schlumberger Technology Corp.). US Patent 3,859,524. 7 Jan 1975. Filed date 26 May 1972. 10p.

An illustrative embodiment of the invention discloses a technique for converting pulsed neutron measurements of certain parameters relating to properties of strata adjacent to a well bore into more accurate indications of those properties. More particularly, thermal neutron decay time measurements, which are usually indicative of the chemical composition of formation fluids, have been subject to hitherto unrecognized sources of error. These measurement conversions are accomplished through the application of predetermined factors derived from parameters that introduced the errors into the measurements. Typically, a compensation is made for the borehold or casing pipe diameter and the salinity of the fluid in the borehole to establish a more

accurate indication of the neutron properties of adjacent formations. (Official Gazette)

22805 NEUTRON PROBE PRACTICE. Bell, J. P. Wallingford, Eng.; Inst. of Hydrology (1973). 63p.

The principles and some applications of the neutron probe are presented. It is intended to give guidance both to the intending purchaser of neutron probe equipment and also to those already using neutron probes but lacking long-term experience. In spite of continued development since 1950, the neutron probe remains primarily a sophisticated research tool. When properly and sympathetically used it can also be employed successfully for routine purposes and can give in situ measurements of soil moisture with a precision obtainable in no other way. However, the neutron probe is easily misused and when this happens poor data may be produced containing large concealed errors. It is hoped that this guide will help the reader to avoid the pitfalls and frustrations which await the unwary in this field. It has been based on the practices developed at the Institute of Hydrology and although it is the Wallingford Probe which is therefore exemplified, the guide should be equally applicable to other instruments. (auth)

22806 MEASURING ON-STREAM PARTICLE SIZE AND SIZE DISTRIBUTION. Stanley-Wood, N. G. (Univ. of Bradford, Eng.). Contr. Instrum.; 6: No. 11, 42-47(Dec 1974).

Instruments which are available for on-stream particle characterization, particularly those used for process control or monitoring contamination control are considered. The properties of an ideal system for on-stream analysis of the particle size spectrum are listed. The Mintex/RSM slurry sizer which detects particles on-stream by β-ray attenuation is described. The use of x-ray fluorescence instruments for assaying mining effluents is considered. The Micromeritics Sedigraph 5000 Particle Size Analyzer which employs x-ray absorption techniques is described. (UK)

22807 METHOD OF INDIRECTLY MONITORING THE OUTPUT OF A PULSED NEUTRON SOURCE. Caldwell, R. L.; Givens, W. W. (to Mobil Oil Corp.). Canadian Patent 954,981. 17 Sep 1974. vp.

The specification discloses a borehole tool for assaying for uranium and having a pulsed neutron source of the accelerator type and a detector for detecting delayed fission neutrons. In operation, the source is periodically actuated to produce very short neutron bursts having a duration of a few microseconds or less. Located adjacent the source is a gamma-ray detector for detecting delayed gamma rays emitted from oxygen in the formations when irradiated with neutrons and resulting from the reaction $^{16}O(n,p)^{16}N$. These gamma rays are recorded to obtain an indirect measure of the neutron output produced by the source. (CA)

22808 EXACTNESS IN DETERMINING SOIL MOISTURE BY NEUTRON PROBE. Schefke, R. (Coll. of Agriculture, Poznan, Poland). Pr. Zakresu Les.; 32: 163-178(1971). (In Polish).

The results of a study on exactness in measuring moisture in sandy soil, using the neutron moisture gauge NIW-1 with the source Pu-Be, are presented. The analysis of exactness of measurements was based on moisture measurements carried out in 4 profiles of meadow soils and in 6 profiles of forest soils. The comparative measurements were made by the gravimetric method. The investigations showed the existence of a high correlation between both methods. The correlation coefficients ranged from 0.901 to 0.975, the standard errors of estimate were from ± 0.86 to $\pm 1.28\%$ of volumetric moisture. The measurements were more exact in meadow soils than in forest soils which was connected with the existence of a layer of roots of trees. Gauge NIW-1 demands drawing separate calibration curves for the given kind of soil and knowing its bulk density. (auth)

22809 MEASURING ACCURACY IN PULSED NEUTRON LOGGING. Chrusciel, E.; Morstin, K.; Starzec, A. (Interdepartmental Inst. of Nuclear Tech., Krakow). Nukleonika; 18: No. 11, 45-59(1973).

A method for estimating the measuring errors inherent in pulsed neutron logging as performed in the three-gate symmetric detection system is described. The overall error in the observed lifetime τ_m of thermal neutrons comprises errors inherent in the statistics of counting and instrumental error due to parameter instability of the time analyzer gates and dead time of the registration system. Two cases are discussed: (a) in situ measurement using scalers; and (b) continuous logging using counting-rate meters. In either of the cases, estimation of the accuracy of measuring τ_m requires a solution of the statistical dependence of signals delivered from various time analyzer channels. (auth)

22810 RADIOMETRIC DENSITY MEASUREMENT USING ^{137}Cs. Mengelkamp, B. (Hartmann and Braun A. G., Heiligenhaus (F. R. Germany)). Elektro-Anz.; 27: No. 7, 132-134(1974). (In German).

4 figs.; 2 refs.

The density measuring apparatus consists of the ^{137}Cs-source and an ionization chamber and can be fixed to tubing with a width of 80 to 500 mm by means of a special holding device. The measuring transducer subsequently connected to the measuring apparatus uses a circuit with zero suppression and temperature compensation. (auth)

22811 RATIONALIZATION BY RADIOMETRIC PROCESS CONTROL. Kosmowski, A. (Frieseke und Hoepfner G.m.b.H., Erlangen (F. R. Germany)). CZ-Chem.-Tech.; 2: No. 5, 199-201(May 1973). (In German).

5 figs.; 2 refs.

Excellent rationalization results can be obtained in the manufacture of areal, band or cord-shaped materials with radiometric measuring and control equipment. The steady further development of apparatus and measuring technique always opens up new applications, some of which of particular interest are considered (mass per unit area and moisture measurement of cardboard, process automization in paper and pulp industry as well as in the plastics and coatings industry, measurement of the tin or zinc coating thickness on steel plate). (GE)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 23406 and 23432.

22812 (AD-785705) STUDIES OF THE NUCLEAR RADIATION PERFORMANCE OF ISOPLANAR INTEGRATED CIRCUITS AND CIRCUIT COMPONENTS. Final Report, 12 July 1972–21 January 1974. Marshall, R. W.; Myers, D. K. (Fairchild Semiconductor, Mountain View, Calif. (USA)). Jan 1974. Contract DAAG39-73-C-0002. 139p. (HDL-TR-002-1). NTIS $5.75.

The report describes the work accomplished in a program to measure and analyze the nuclear radiation performance of transistors, diodes, and integrated circuits fabricated with the standard Fairchild isoplanar processes, the Fairchild dielectrically isolated isoplanar process, and the Fairchild isopoly or V-groove dielectric isolation process. These devices were characterized electrically and then exposed to ionizing dose, transient gamma, and fast neutron radiation environments to determine the effects of these environments on device performance. The possibility of new and/or different failure modes that could limit the use of these devices in the various radiation environments was investigated. (auth)

22813 (AD-786022) RADIATION HARDENING OF LINEAR MICROCIRCUITS BY TERMINAL PHOTOCOMPENSATION. Final Report, 15 April 1972–1 August 1973. Pocock, D. N.; Krebs, M. G. (Northrop Research and Technology Center, Hawthorne, Calif. (USA)). Jun 1974. Contract F29601-72-C-0084. 124p. (AFWL-TR-73-110). NTIS $5.25.

The feasibility of using terminal photocompensation to reduce the ionizing-radiation vulnerability of linear microcircuit amplifiers was investigated. An analytical basis for terminal photocharge compensation is presented. Linear terminal models were developed for four types of integrated circuit amplifiers and are used to analyze the qualitative effects of terminal photocompensation. Experimental results show that two of the four microcircuits can be photocompensated with at least an order-of-magnitude reduction in the radiation-induced noise energy for several cases of external circuit configuration and radiation intensity. (auth)

22814 (AD-786024) REWORK OF LINEAR INTEGRATED CIRCUITS. Final Report, 31 May 1972–18 February 1974. Lipman, J. A. (Texas Instruments, Inc., Dallas (USA)). Jun 1974. Contract F29601-72-C-0095. 72p. (AFWL-TR-74-53). NTIS $4.25.

AC probe techniques for screens and controls were evaluated to ensure radiation hardness of integrated circuits (ICS). A dielectrically isolated, photocurrent compensated linear IC was the test vehicle. A special metal pattern was used to isolate and provide probe pad leads for each active device on the IC. Air Force Weapons Laboratory personnel then probed the devices to determine the parameters that might indicate neutron hardness assurance. After the probing, the metal pattern was removed from a number of the devices which were then processed normally with

NICR, metal, and quartz overcoat. Possible damage to the silicon transistors caused by the special or the normal processes was evaluated by photographing a number of the bars and some slices from the devices. A unique procedure was used to label the separate bars so that their physical location on the slice could be determined after dicing. (auth)

22815 (AD-786419) STUDY OF BULK TRAPPING EFFECTS IN RADIATION-RESISTANCE MOS DEVICES. Final Report, 30 June 1972–31 December 1973. Oldham, W. G. (California Univ., Berkeley (USA). Electronics Research Lab.). May 1974. 32p. (AFCRL-TR-74-0224). NTIS $3.75.

The properties of MOS transistors were examined before and after exposure to large neutron fluences. The effect is concentrated on three phenomena, judged to be the most serious limitations on ultimate device hardness: (1) trapping of carriers in radiation induced deep levels, (2) degradation of the mobility of carriers in the channel, and (3) punch-through from drain to source. Data are obtained on three classes of devices (1) hardened MOS transistors manufactured by Hughes, (2) MOS transistors manufactured at Siliconiz, and (3) several special vertical pnp and npn structures. (auth)

22816 (AD-786722) ENGINEERING TECHNIQUES FOR ELECTROMAGNETIC PULSE-HARDNESS TESTING. Final Report. Whitson, A. L. (Stanford Research Inst., Menlo Park, Calif. (USA)). 16 Sep 1974. Contract DASA01-71-C-0087. 260p. (DNA-3332F). NTIS $8.50.

The text describes instrumentation and test techniques that are applicable for testing systems to determine the hardness of electromagnetic pulse (EMP). Energy sources, simulation techniques, test instrumentation, and testing techniques are described. Emphasis is on testing that can be accomplished by engineers with knowledge of electromagnetics and circuits. Complicated systems that require special expertise are described only to acquaint the reader with their characteristics. This text is intended to supplement the testing portion of DNA 2772T "DNA EMP Awareness Course Notes." (auth)

22817 (AD-787102) NEUTRON RADIATION RESPONSES OF MOTOROLA XCE 1571 OPERATIONAL AMPLIFIERS. Notthoff, J. K. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Oct 1971. 14p. (MDC-G-2475). NTIS $3.25.

The XCE 1571 is a new, experimental design of a radiation-hardened linear amplifier. Two samples of this circuit were obtained and irradiated at the White Sands Missile Range Fast-Burst Reactor (WSMRFBR). The results of this test are given. (GRA)

22818 (AD-787105) NEUTRON RADIATION RESPONSES OF MOTOROLA MCE 54H79 DUAL TYPE-D FLIP-FLOPS. Notthoff, J. K. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Oct 1971. 17p. (MDC-G-2474). NTIS $3.25.

The high-power logic circuits (RSN54H00 series) have been quoted to function within nominal data sheet specifications at a neutron fluence of 5×10^{14} n/cm^2 (E > 10 keV). To determine the degradation beyond this point and how it would restrict circuit performance, two Motorola 54H79 dual-D flip-flop samples were tested to a total fluence of 1.9×10^{15} n/cm^2 (E > 10 keV). The tests were performed at the White Sands Missile Range Fast-Burst Reactor (WSMRFBR). The report presents the results of this test. The 54H79 can be considered representative for the whole 54H00 family. (GRA)

22819 (AD-787106) RADIATION-HARDENED OPERATIONAL AMPLIFIER DEVELOPMENT. Notthoff, J. K. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA). Space Sciences Dept.). May 1973. 104p. (MDC-G-3893). NTIS $5.25.

The report describes the development and detailed test results of radiation-hardened linear amplifiers capable of operating in severe gamma and neutron radiation environments. The Motorola MCE 7041F and Texas Instruments RSN 52800 hardened operational amplifiers were tested and characterized in pulsed ionizing radiation environments at dose rates up to 2×10^{11} rad(Si)/S and in fast neutron environments up to fluences of 10^{15} neutrons/cm^2. The test results show that the MCE 7041F parts are acceptable at fluences of 3×10^{14} n/cm^2 if input offset voltages in the order of 10 mV can be tolerated. For higher fluences, the addition of a differential JFET input stage is necessary to minimize input offset voltage and current, and to enhance open-loop gain. A successful selection criteria for the JFET input pair has been established. With the hardened JFET input stage and the MCE 7041F, many linear circuit functions can be implemented at fluences as high as 5×10^{14} n/cm^2. For functions requiring high accuracy, input offsets must be minimized by sample-and-null or chopper-stabilization techniques. (auth)

22820 (AD-787482) EMP PREFERRED TEST PROCEDURES (SELECTED ELECTRONIC PARTS). Bridges, J. E.; Emberson, W. C. (IIT Research Inst., Chicago, Ill. (USA)). 29 Aug 1974. Contract DNA001-72-C-0089. 182p. (DNA-3286H). NTIS $7.00.

Recommended EMP test procedures are provided to evaluate or characterize the performance of filters or surge arrestors. Areas covered in detail are experiment design, documentation, representative EMP induced transients, and test procedures to evaluate the EMP behavior of surge arrestors and filters. (auth)

22821 (AD-787620) TRANSIENT UPSET TOLERATION AS AN EMP HARDENING TECHNIQUE. Topical Report. Graham, W. R.; Houston, J. B. (R and D Associates, Santa Monica, Calif. (USA)). 5 Aug 1974. Contract DNA001-72-C-0197. 26p. (RDA-TR-2301-010). NTIS $3.75.

Both transient circuit upset and permanent component damage can produce serious malfunctions in modern electronic equipment. Although the issue is not yet clear, it may be possible to design and select components which have a much higher threshold to permanent damage than to transient upset. If this proves to be possible, then a degree of electromagnetic pulse (EMP) hardness would be achieved through designing systems to be completely insensitive to the effects of transient circuit upset. The characteristics of the developed techniques for tolerating transient upset are described. Various overall system design approaches are discussed. The relation of specific upset toleration techniques to the system design approaches are illustrated. (auth)

22822 (RN-S-0326) STRAIN GAGE PRESSURE TRANSDUCER EXPERIMENT 23/R511. Final Data Report. Oggerino, J. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 87p. Dep. NTIS $7.50.

Four Statham Model PA-812 and four Standard Controls Corporation Model 170-9 pressure transducers were irradiated in the Plum Brook Reactor Facility at Sandusky, Ohio. Both sets of transducers were subject to output signal degradation in excess of 25% of baseline values at a gamma heating rate of 0.5 watts/gm. However, inadvertent pretest water damage of transmission cable assemblies contributed to the signal degradation. Posttest examinations revealed that physically the strain gage portion of the Statham transducers satisfactorily withstood the exposure. The integrated fast neutron flux was 9.0×10^{15} n/cm^2 (E_n > 1.0 MeV); the gamma dose was 3.0×10^8 Rads (C). (auth)

22823 (RN-S-0529) EVALUATION OF TEST RESULTS FOR THIN-FILM PRESSURE TRANSDUCER. Sita, E. R. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 171p. Dep. NTIS $11.75.

Four Statham Model PA812 (P/N 50390-1) thin-film pressure transducers were irradiated in the in-pile tube of the Aerospace Systems Test Reactor (ASTR) at General Dynamics, Fort Worth, Texas (GD/FW) on August 21, 1967. The 23/R512A test was a development irradiation test of a candidate pressure transducer type, to be used to monitor the nozzle chamber pressure of the NERVA engine control system. Statham Model PA812 (P/N 50390-1) is a redesign of Statham Model PA 812 (P/N 16647) that was previously tested in the Plumbrook Test Reactor and on the NRX-A5 engine. The primary purpose of this experiment was to determine qualitatively the performance characteristics of the redesigned candidate NERVA flush-mounted pressure transducer. The test was conducted in a simulated engine-mounted configuration, with radiation and temperature environments in excess of anticipated full-power engine requirements. Results are presented and discussed. (WHK)

22824 (TID/SNA-304) RADIATION EFFECTS ON ELECTRONICS. Preliminary Guidelines for Designing Electronics for Operation in a Radiation Environment. Messenger, G. C.; Stadig, J. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 89p. Dep. NTIS $7.50.

Preliminary guidelines for designing radiation-hardened electronics for use in the NERVA program are given. Effects of neutrons and gamma radiation on semiconductor electrical properties, effects of radiation on device operation, circuit analysis, and system hardening are discussed. (WHK)

22825 (TID/SNA-305) SUPPLEMENT TO s110-XCE01-W181. Radiation Effects on Electronics. Preliminary Guidelines for Designing Electronics for Operation in a Radiation Environment. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1969. 204p. Dep. NTIS $13.25.

This report contains reproductions of seven papers entitled: Radiation Hardening of Electronic Systems; Neutron Damage Con-

stant for Bipolar Transistors; Radiation Effects on Semiconductor Devices; Statistical Modeling of Semiconductor Devices for the TREE Environment; A Two Level Model for Lifetime Reduction Processes in Neutron Irradiated Silicon and Germanium; Radiation Effects on Microcircuits; and Circuit and Systems Analysis. (WHK)

22826 (TID/SNA-774) RADIATION EFFECTS ON ELECTRONICS. Preliminary Guidelines for Designing Electronics for Operation in a Radiation Environment, s110-XCE01-W181. Messenger, G. C.; Stadig, J. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Sep 1970. 91p. Dep. NTIS $7.75.

Topics include an introduction to system hardening, effects of neutrons on semiconductor electrical properties, effects of gamma radiation on semiconductor electrical properties, effects of radiation on device operation, and circuit analysis. (WHK)

22827 STATISTICAL DISTRIBUTION OF NEUTRON SEMICONDUCTOR DEVICE DEGRADATION. McKenzie, J. M. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 5, 23-27(Oct 1974).

The population of permanent neutron degradation of base current per unit neutron fluence is normally distributed. The standard deviation of the population is about 10% of the mean degradation. This information is used to estimate circuit failures after a neutron pulse. (auth)

22828 RADIATION-HARDENED CMOS DEVICES AND CIRCUITS. Hughes, H. L. (to Secretary of the Navy). US Patent 3,862,930. 28 Jan 1975. Filed date 22 Aug 1972. 4p.

A technique of reducing the radiation sensitive nature of both P-channel and N-channel components of a CMOS structure is described. The channel oxide in both components is grown as pure as possible during the manufacture with a special attempt to keep the alkali content low. After the manufacturing process is complete, the P-channel component is masked while the entire N-channel component is subjected to an ion implantation which radiation hardens the entire CMOS device or circuit. This process provides a CMOS device which maintains a useable threshold level in the presence of and after it has been exposed to 10^6 rad of radiation. (Official Gazette)

22829 PROTECTION AGAINST JUNCTION BURNOUT BY CURRENT LIMITING. Burger, J. R. (TRW Systems Group, Redondo Beach, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 5, 28-30(Oct 1974).

This paper provides design curves which determine optimum resistor or inductor values for surge protection, provided that an upper bound on surge duration and circuit supply voltages are known. The resistor or inductor values are optimized in the sense that maximum theoretical energy transfers to semiconductor junctions are equated to predetermined burnout thresholds. (auth)

22830 RADIATION DAMAGE IN Ge(Li) DETECTORS. Graf, J. M. Charlottesville, VA; Univ. of Virginia (1974). 278p. University Microfilms Order No. 75-4679.

Thesis (Ph. D.).

Lithium-drifted germanium gamma-ray detectors were systematically exposed to reactor spectrum neutrons in order to measure the fluence level at which radiation damage severely deteriorates detector resolution. Dependence of resolution, leakage current and capacitance on fast neutron fluence as well as the recovery of the detectors by annealing were examined in terms of proposed radiation damage models. In successive runs, three planar detectors were exposed in steps and at different fluence rates to neutrons in the fast neutron beam facility at the University of Virginia Reactor. It was found that these detectors could "tolerate" a fluence of 10^{13} n/cm^2 ($E_{neutron}$ > 500 eV). Above this level all three detectors showed signs of deterioration. Restoration of good energy resolution was achieved by warming the detector to room temperature for approximately two hours. Redrifting the detector restored the diode leakage current and capacitance characteristics, but did not significantly improve the resolution over that following the warm-up to room temperature. A critical comparison of these results with published results indicates that the damaging effect of all neutrons down to the atomic displacement threshold (500 eV in Ge) must be considered. A consistent interpretation of the two sets of data is possible if the damage response function in Ge(Li) detectors is assumed to be proportional to the number of primary neutron interactions (i.e., the number of damage regions) rather than the customary interpretation in terms of the total number of atomic displacements. (Diss. Abstr. Int., B)

22831 INTERACTION OF CYLINDRICAL POSTS AND RADIATION-INDUCED ELECTRIC FIELD PULSES IN IONIZED MEDIA. Merewether, D. E.; Ezell, T. F. (Mission Research Corp., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 5, 4-13(Oct 1974).

The electric field dependence of air conductivity allows the presence of a metal body to influence the electromagnetic fields generated by an ionizing radiation environment. The numerically determined results provided illustrate that the interaction can be significant, particularly in weakly ionized media or at low air pressures when air breakdown at the extremities of metallic structures can occur. (auth)

Miscellaneous Instruments

Refer also to abstracts 22565, 22585, 22859, and 25185.

22832 A SIMPLE AND INEXPENSIVE COLLIMATOR FOR NEUTRON RADIOGRAPHY. Olsen, J.; Mortensen, L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nucl. Instrum. Methods; 121: No. 3, 617-618(1 Nov 1974).

A neutron beam collimator was constructed by means of plastic drinking "straws". The properties of the collimator were investigated, and especially the distribution of the neutrons at different distances. (auth)

22833 A DIGITAL GATE UNIT FOR TWO-PARAMETER MULTICHANNEL ANALYSIS. O'Brien, G. E.; Baker, K. R.; Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). Nucl. Instrum. Methods; 121: No. 3, 567-572 (1 Nov 1974).

A digital gate unit for use in two-parameter multichannel analysis has been designed and constructed. A complete description is given of the five basic units: the peak detector, and ADC, the digital SCA units, the control logic, and the routing and coincidence logic, all of which fit into a triple width NIM module. The control and routing logic is designed specifically for a Nuclear Data Model ND-2200 analyzer. (auth)

22834 THE LOGIC DESIGN OF HIGH PRECISION TIME-TO-PULSE-HEIGHT CONVERTERS. I. General Problems and Logic Structure of a Converter. Bertolaccini, M.; Cova, S. (Consiglio Nazionale delle Ricerche, Milan (Italy)). Nucl. Instrum. Methods; 121: No. 3, 547-556(1 Nov 1974).

A thorough examination is made of the main sources of error and delay distribution distortion in time measurements employing time-to-amplitude converters (TAC). The logic requirements a modern high precision, high speed and wide range TAC should possess to avoid these errors are then discussed. Logic features not essential for the correct performance of the TAC, but generally useful and therefore of practical importance, are also considered. (auth)

22835 THE LOGIC DESIGN OF HIGH PRECISION TIME-TO-PULSE-HEIGHT CONVERTERS. II. A Converter Design Based on the Use of Integrated Circuits. Bertolaccini, M.; Cova, S. (Consiglio Nazionale delle Ricerche, Milan (Italy)). Nucl. Instrum. Methods; 121: No. 3, 557-566(1 Nov 1974).

A complete and detailed description is given of a TAC built using integrated circuits. Attention is focused on its logic by discussing block diagrams without considering details of the actual circuitry. Thus an example is given of a practical solution of the problems discussed in part I. Some experimental results characterizing the performance of the instrument are also given. (auth)

22836 A GENERAL PURPOSE SYSTEM FOR EXPERIMENTAL SIMULATION AND DESIGN. Wolberg, J. R. (Technion-Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods; 121: No. 2, 391-395(15 Oct 1974).

Prediction analysis is a method for simulation and design of quantitative experiments. A general purpose least-squares program called REGRESS includes an option for applying this method to simulation of proposed experiments. Thus the same program can be applied to both design and data analysis of an experiment. This paper briefly describes the method of prediction analysis and the REGRESS simulation features. A specific example is included to illustrate the value of simulation in designing an experiment. (auth)

22837 LONGITUDINAL MAGNIFICATION IN RADIOLOGIC IMAGES OF THICK OBJECTS: A NEW CONCEPT IN MAGNIFICATION RADIOGRAPHY. Doi, K.; Rossmann, K. (Univ. of Chicago). Radiology; 114: No. 2, 443-447(Feb 1975).

New concepts which are useful for evaluating image resolution and distortion in magnification radiography are introduced. It is shown theoretically and experimentally that "longitudinal magnification" defined as the ratio of the magnified image size to the conventional image size for objects located in a plane perpendicu-

lar to the film, is given approximately by the square of the conventional magnification. Resolution in the radiographically magnified image of such objects is much higher than that obtained by optical magnification. This is confirmed experimentally by radiographs of square-wave test objects. The related image distortion is also discussed. (auth)

22838 EVALUATION OF HIGH-SPEED SCREEN-FILM COMBINATIONS IN ANGIOGRAPHY. Ovitt, T. W.; Moore, R.; Amplatz, K. (Univ. of Minnesota, Minneapolis). Radiology; 114: No. 2, 449-452(Feb 1975).

Various high-speed screen-film combinations were evaluated to compare increase in speed, loss of resolution, and increase in radiographic mottle. Results indicate that the rare-earth film-screen system is the fastest and has a higher x-ray absorption efficiency. The Kodak X-Omatic screen has the greater resolving power but is slower than the high-speed calcium tungstate system. A smaller focal spot can be used with the fast speed of the rare-earth system to increase resolution. (auth)

22839 PERFORMANCE OF MICROWAVE PRESSURE/TEMPERATURE SENSOR IN LIQUID SODIUM. Billeter, T. R. (Hanford Engineering Development Lab., Richland, WA). IEEE Trans. Nucl. Sci.; NS-21: No. 5, 14-22(Oct 1974).

The theory of operation and experimental test results of a microwave instrument for measuring pressure and temperature in liquid sodium are described. At discrete frequencies, the single, all-metal, hollow cylindrical sensor absorbs energy provided by a wide-bandwidth sweep-frequency microwave oscillator. For the designed sensor, the frequencies of two detected absorption signals relate to temperature whereas the difference frequency relates to pressure. Operational characteristics of the sensor and associated instrumentation were determined over a temperature range of 350 to 1100°F and over a pressure range from atmospheric to 190 psia. Time response of the unit for pressure transients was also ascertained. Total duration of the test approximated 350 hours. (auth)

22840 ACCURATE LOGARITHMIC RATEMETER FOR RANDOM PULSES. Fraser, H. J. (Australian Atomic Energy Commission, Lucas Heights). IEEE Trans. Nucl. Sci.; NS-21: No. 5, 31-38(Oct 1974).

A new principle of obtaining an accurate wide range logarithmic response to random pulse rates is described. The logarithmic law is achieved by summing the averaged outputs of a chain of flip-flops which are all set (or reset) by the common train of random input pulses and which are reset (or set) by different but related clock rates obtained from clock frequency divider circuits. A practical log-ratemeter is described which utilizes this principle and which illustrates the inherent simplicity, stability, wide range potential and designability of the circuit involved. This ratemeter uses Transistor Transistor Logic and covers the range 1 to 10^7 counts per second. (auth)

22841 CUTOFF CHARACTERISTICS OF ROTATING GRIDS. Bull, K. W.; Curry, T. S. III, Dowdey, J. E.; Christensen, E. E. (Univ. of Texas, Dallas). Radiology; 114: No. 2, 453-455(Feb 1975).

The cutoff characteristics of rotating grids are qualitatively and quantitatively different from those of comparable stationary grids. Rotating grids focus to a point in space so lateral decentering occurs in all directions from the central axis of the grid. Consequently, they cannot be used for oblique radiographic techniques. For any type or amount of decentering, cutoff is approximately one-third less for rotating grids. (auth)

22842 EVALUATION OF A CONTINUOUSLY VARIABLE COLLIMATOR FOR 14 MeV NEUTRONS. Beach, J. L.; Kelsey, C. A. (Univ. of Wisconsin, Madison). Phys. Med. Biol.; 20: No. 1, 47-53(Jan 1975).

A continuously variable collimator for 14-MeV neutrons is evaluated. Beam profiles measured in air and a phantom were used to demonstrate the relative importance of patient scatter and collimator throat scatter as they limited the performance characteristics of the collimator. The collimator consisted basically of two sets of jaws each composed of 30 cm of steel followed by 20 cm of polyethylene. A solution is presented for the asymmetry in vertical and horizontal collimating characteristics resulting from the use of thick collimators. Beam profiles obtained with the collimator were comparable to published values for a fixed field 14 MeV neutron collimator. (auth)

22843 COMBINED ION PROBE/SPARK SOURCE ANALYSIS SYSTEM. Banner, A. E.; Stimpson, B. P. (Associated Electrical Industries Scientific Apparatus Ltd., Manchester, Eng.). Vacuum; 24: No. 10, 511-517(Oct 1974).

From workshop on methods of obtaining compositional analysis of solids as a function of depth; Pretoria, South Africa (1 May 1974).

Spark source mass spectrometry and secondary ion mass spectrometry have complementary advantages in the elemental analysis of solids. The AEI IM20 ion probe and MS702R mass spectrometer form a composite instrument incorporating both techniques; the design and different operating modes are described. A primary ion beam diameter as low as 2 μm can be obtained under favorable circumstances; the minimum detectable concentration of a typical element is derived as a function of this diameter. The mass resolution is greater than 5000 (10% valley definition) with electrical detection and 10,000 (50% density definition) with photographic detection; this resolution is much higher than that obtained with other secondary ion mass spectrometers. Two typical applications illustrate that such high mass resolution is a necessary prerequisite to quantitative interpretation in secondary ion mass spectrometry: precise isotopic analysis of titanium is demonstrated and the concentrations of impurity transition elements derived from ion probe and spark source analyses of a geological olivine are compared. (auth)

22844 ON-LINE COMPUTERS IN NUCLEAR RESEARCH. Borchers, R. R. (Univ. of Wisconsin, Madison). pp 483-497 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The main concepts of computer organization are introduced; the functions of a computer in a nuclear laboratory are reviewed; the peripheral equipment that is needed for a system to communicate and store date is described; and the software or programming that is required to make the system useful is discussed. (WHK)

22845 COMPUTER CONTROLLED ION COUNTING ISOTOPIC RATIO MASS SPECTROMETER. Schoeller, D. A.; Hayes, J. M. (Indiana Univ., Bloomington). Anal. Chem.; 47: No. 3, 408-415 (Mar 1975).

A new system for the differential measurement of stable isotope ratios is described and applied to carbon isotope ratio measurements using carbon dioxide. The instrument is under closed-loop computer control utilizing accelerating voltage scanning and ion-counting detection. The observed performance over more than one year's use indicates a precision of 0.5‰ (standard deviation) and a minimum total sample size of 10^{-7} g carbon as CO_2. The effects of coincidence count losses and other instrumental parameters are discussed. (auth)

22846 SHAPER PRODUCING POWERFUL PULSES WHICH IS BASED ON AVALANCHE TRANSISTORS. D'yakonov, V. P.; Zienko, S. I.; Remnev, A. M. (Moscow Power Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1039-1041(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 89-91(1974).

A pulse shaper based on avalanche transistors is described which shapes pulses having an amplitude of up to 600 V across a load of $R_1 = 100\ \Omega$ which is shunted by a capacitance $C_L = 100$ pf. The length of the pulses is $t_p = 0.3\ \mu$sec, and the rise time is $t_1 = 15$ to 20 nsec. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

22847 (COO-3077-72) NUMERICAL DESIGN OF TRANSONIC CASCADES. Korn, D. G. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). Jan 1975. Contract AT(11-1)-3077. 103p. Dep. NTIS $8.25.

A method developed for the design of wing sections which exhibit shock-free flow at high subsonic speeds has been applied to the problem of cascade design. A cascade is a periodic distribution of two dimensional blade cross sections which serves as a basis for the design of axial flow compressors and turbines. This technology could be the basis for the design of improved axial flow compressors used for the production of enriched uranium at gaseous diffusion plants. Those aspects of the design procedure which are used for both airfoil and cascade design are reviewed briefly. Emphasis has been made on the differences, namely in the form of the singular solution in the hodograph plane. The singular solution for flow around an airfoil consists of a pole and a nearby branch point in the hodograph plane. The singular solution for the cascade is formed by two logarithmic singularities resembling a source and sink. A listing of the computer program used to design transonic cascades with this method is included. (auth)

22848 (JAERI-M-5732) HYBRID SIMULATION OF GASEOUS DIFFUSION PLANT. Shimazaki, J.; Hara, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 61p. (In Japanese). Dep. NTIS (US Sales Only).

A gaseous diffusion plant normally consists of over a thousand separators in cascade to obtain a specified slightly-enriched uranium. In order to analyze the dynamic behavior of the concentration of ^{235}U versus external disturbances, the basic dynamic equations for the plant are examined and the digital-analog hybrid simulations are developed. The static characteristics are exactly included in these dynamic models, and reductions of the equations for permissible approximations are described. Each block in the models is presented in the form of a set of a nonlinear partial differential equation and an associated boundary condition. Therefore trimming of these boundary conditions could be effective in the simulations of various practical cases, but actually it requires to solve two-point boundary value problems. In start-up study of the plant, a simulation using a CSDT method is described, and effectiveness of a nodal method is also proposed in the appendix, considering that the distribution of the concentration is rather moderate. (auth)

22849 (LIB/Trans-546) INDUSTRIAL OUTLINES OF URANIUM ENRICHMENT. Villani, S. Translated by E. Trenga from Energ. Nucl. (Milan); 21: No. 7, 403-408(Jul 1974). 17p. Dep. NTIS (US Sales Only) $4.00.

The present situation of the uranium enrichment industry in Europe is illustrated both from the technical and commercial viewpoint. The processes taken into consideration are gaseous diffusion and centrifugation. Some cost data, both current and projected, are analyzed. Also the contract terms adopted by the main enrichment suppliers are briefly described. (auth)

22850 (ORO-3913-5) SEPARATION OF HYDROGEN ISOTOPES BY HEATLESS ADSORPTION. Progress Report, October 1, 1972–August 31, 1973. Weaver, K.; Hamrin, C. E. Jr. (Kentucky Univ., Lexington (USA). Dept. of Chemical Engineering). [nd]. Contract AT(40-1)-3913. 93p. Dep. NTIS $7.75.

Thesis. Submitted by K. Weaver.

A hydrogen stream containing 5.5% deuterium were continuously separated using a single staged heatless adsorber packed with metallic palladium deposited on alumina. Enrichments of up to 17.5% were achieved. Eleven heatless adsorption runs were made to examine the effect of the purge to feed ratio and cycle time. The results were compared to Shendelman's Model and a mass balance model. Several additional runs were made to determine the capacity of the column and the separation factor. As the purge to feed ratio, γ, increased from 0 to 3.0 better separations were achieved although the quantity of product decreased. A critical value of γ appeared to be in the range 1.0 to 1.2. As the cycle time increased from 1 to 8 minutes, the quantity of product increased, but the magnitude of the separations decreased. Shendelman's Model was found not to be applicable to this particular system because of several of his simplifying assumptions. However, the Mass Balance Model accurately predicted the effect of varying γ and cycle time. (auth)

22851 NEON ISOTOPE SEPARATION IN A ROTATING PLASMA. Heller, H.; Simon, M. (Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (F.R. Germany)). Phys. Lett., A; 50: No. 2, 139-140(18 Nov 1974).

A separation of neon isotopes has been accomplished in a rotating plasma. Separation factors of 1.09 to 1.11 have been achieved. (auth)

22852 COLD TRAP FOR PURGING AIR FROM A GAS DIFFUSION SYSTEM. Benedict, M. (to Director of Scientific Research and Development Office for Emergency Management). US Patent 3,859,808. 14 Jan 1975. Filed date 5 Apr 1946. 8p.

Apparatus is described for the separation of a gas mixture comprised of a condensable constituent and a noncondensable constituent that comprises a trap chamber, a first source of said gaseous mixture, an auxiliary source of said non-condensable constituent, a conduit for delivering said gaseous mixture from said first source to said trap chamber and means responsive to the mol percentage of the non-condensable constituent at a point in said conduit for adding non-condensable constituent from said auxiliary source to said conduit to maintain the mol percentage of said non-condensable constituent at a constant value. (Official Gazette)

22853 COLD TRAP SYSTEM FOR RECOVERING CONDENSABLE GAS FROM A VESSEL TO BE EVACUATED. Benedict, M.; Thompson, W. I.; Parrish, R. L. (to Energy Research and Development Administration). US Patent 3,859,807. 14 Jan 1975. Filed date 26 Aug 1947. 6p.

A system is described for recovering a condensible gas by solidifying the same in a cold trap that comprises a vessel to be evacuated, a pump having an inlet and an outlet side and arranged to withdraw gas from said vessel, means connecting said vessel with the intake side of said pump, a refrigerated cold trap for solidifying said gas, said trap having an inlet and an outlet, means connecting the inlet of said cold trap with the outlet side of said pump, an absorbent trap connected with the outlet of said cold trap and arranged to absorb traces of the condensible gas passing through said cold trap, and means for admitting an inert and relatively incondensible gas into said vessel to purge the condensible gas therefrom. The system can recover uranium hexafluoride gas by solidifying the same in a cold trap that comprises a diffusion cell to be evacuated, a vacuum pump having an inlet and an outlet side and arranged to withdraw said gas from said cell, means connecting said cell with the inlet side of said pump, a refrigerated cold trap for solidifying said gas, said trap having an inlet and an outlet, heating means associated with said cold trap whereby the contents of said trap may be converted to a fluid state, means connecting the inlet of said cold trap with the outlet side of said pump, said means including a filter arranged to remove traces of pump oil from the gas being withdrawn from the cell, a fluorocarbon trap connected with the outlet of said cold trap and arranged to absorb traces of uranium hexafluoride gas passing through the cold trap, means for admitting dry nitrogen gas to said cell to purge the uranium hexafluoride gas therefrom, and means for returning the uranium hexafluoride gas to said cell from said cold trap. (Official Gazette)

22854 ISOTOPE SEPARATION IN A SEEDED BEAM. Anderson, J. B. (Pennsylvania State Univ., University Park); Davidovits, P. Science; 187: No. 4177, 642-644(21 Feb 1975).

A new method of separating isotopes in a gaseous mixture is described. The method takes advantage of the differences in velocities of isotopic species in a molecular beam formed by expansion of the mixture with a light gas from a nozzle source. For the separation of the hexafluorides of uranium-235 and uranium-238 the technique has an estimated separative work factor about 500 times higher than the gaseous diffusion process and 100 times higher than the curved-jet method. (auth)

22855 FLOW OF AN ISOTOPIC MIXTURE IN CHANNELS WITH POROUS WALLS. Airoldi, A.; Caldirola, P.; Fiocchi, R. (Univ., Milan). Energ. Nucl. (Milan); 22: No. 1, 17-26(Jan 1975).

The flow of an isotopic gas mixture in a channel with flat porous walls is discussed. Generalizing procedures previously followed by one of the authors of this paper and by American authors, a method was developed which is suitable for solving fluiddynamic equations in laminar flow for values of Reynolds number Re, of suction velocity $\bar{w}_0$, and of emission velocity c satisfying the relation Re $\bar{W}_0/c \leq 30$ (where $\bar{W}_0$ is the nondimensionless global motion velocity of the mixture). The results obtained are applied to the calculation of the diffusion layer of the fluid along the walls and of the influence of this layer on the efficiency of uranium isotope separation by gaseous diffusion. (auth)

22856 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 3. Heavy Water. Toronto; Canadian Nuclear Association (1974). vp. (CONF-740681-P3; 74-CNA-300).

Five papers on heavy water production in Canada were presented at the conference. A separate abstract was prepared for one paper. Four papers were previously abstracted for NSA. For abstracts of these see CONF-740681 in the Report Number Index. (LCL)

For an abstract of an individual paper see: 22857.

22857 HEAVY WATER SUPPLY. Haywood, L. R. (Atomic Energy of Canada Ltd., Ottawa). pp Paper 304, 3p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 3. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

During 1973, production of heavy water from the only two operating plants in Canada, at Port Hawkesbury and Bruce, was severely limited by foaming in the first-stage towers. The trouble has been cured at the expense of a small decrease in extraction efficiency, so that production for the first quarter of 1974 was at a rate of 1Gg/year, 93% of the design capacity (the full capacity may yet be attainable). By 1980, production should be 4Gg/year, which will satisfy Canadian needs up to 1985, so that plans for any more plants depend on export sales of CANDU reactors. For Bruce, using nuclear steam, a 1980 price of $80/kg can be predicted (1974$), but it would be $110 if fossil-fired steam were used. (CA)

22858 WILL TRADE IN URANIUM ENRICHMENT TECHNOLOGY INCREASE WEAPONS SPREAD. Salaff, S. Sci. Forum; 7: No. 6, 14-17(Dec 1974).

Japan is wholly dependent on U. S. fissile fuel supplies for its power reactors. Uranium enrichment capacity is levelling off, but demand is increasing. A joint Japan-U. S. agreement for the construction of a uranium enrichment plant in the U. S. was completed some time ago; however, the U. S. is hesitant about revealing its most advanced uranium enrichment methods since the transfer of gaseous diffusion technology is likely to reduce the technical problems to nuclear weapon manufacture. (CA)

22859 ON-LINE MASS SEPARATION. Klapisch, R. (Center for Nuclear and Mass Spectrometry, Orsay, France). pp 213-242 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Methods for direct separation of fast reaction products are discussed including Mattauch-Herzog and focusing parabola mass spectrographs, the gas-filled mass spectrometer, and hybrid techniques. Also, methods for separation of stopped fragments are described including on-line mass spectrometers and on-line isotope separators. (WHK)

22860 AN ECONOMICAL COMPARISON OF URANIUM ENRICHMENT METHODS. Braun, R.; Geipel, H. (SIT Studiengesellschaft fuer Uranisotopentrennverfahren m.b.H., Essen (F. R. Germany)); Iwand, J. (Geisenberg A. G., Essen (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 11, 536-539(Nov 1974). (In German).

4 figs.; 6 tabs.; 5 refs.

An economical comparison of the different enrichment methods is a very topical one, as world-wide decisions on the construction of new uranium enrichment capacities have to be made. A comparison of the methods is very difficult due to the different development status and development potential as well as the limited availability of data, caused by the secrecy regulations. The greatest uncertainties in judging the different methods are in the field of capital costs. Centrifuge, diffusion, and separating nozzle systems are compared on the basis of known technologies and variation of electricity costs. Considered are those plants with a capacity of 1,000 metric tons per year USW (at diffusion and separating nozzle partial capacity) and an availability of 20 years, reaching full production by 1982 and running at full load after being operational. It turns out that the economy of the centrifuges is considerably influenced by capital and maintenance costs, though being rather independent of development and electricity prices. The economy of diffusion and separating nozzle, however, depends not only on capital costs, but also decisively on the electricity prices. (auth)

Isotopic Power Sources

Refer also to abstracts 22359, 22360, 22362, and 22369–22376.

22861 (AED-CONF-74-509-018) NEUTRON SPECTRA FROM RADIONUCLIDE SOURCES FOR CARDIAC PACEMAKERS. Kluge, H. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). 1974. 12p. (In German). INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

The spectra from two complete cardiac pacemakers whose radionuclide batteries are operated, the one with ^{238}Pu in metallic form, the other with $^{238}PuO_2$, as well as of two $^{238}PuO_2$ radionuclide sources in the energy region above 0.7 MeV, have been investigated by means of a recoil proton scintillation spectrometer (NE 213). Fluence-energy dose and fluence-equivalent dose were calculated using the conversion factors obtained from the spectrum for the case of the irradiation of a cylindrical phantom with a wide, parallel bundle. The maximum values of these conversion factors deviate for the various spectra by a maximum amount of 11% from the corresponding values for a ^{252}Cf spectrum. As similar small differences can be expected in the case of an implanted cardiac pacemaker, one can refer to literature values for implanted ^{252}Cf sources for the determination of the dose capacities in man. (GE)

22862 (ANSP-M-11) HEAT AND MASS TRANSFER CORRELATION EQUATIONS FOR SUBLIMING GRAPHITE IN HIGH SPEED FLOW. Perini, L. L. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). Aug 1974. 49p. (AEC/SNS-3060-011). Dep. NTIS $5.50.

Current correlations for the mass loss rate of graphite in the sublimation regime are reviewed and it is concluded that the models are inappropriate for use in an aerothermal analysis of nuclear heat source reentry bodies. Employing current thermochemical data and heat and mass transfer coefficients a new set of correlation equations have been developed. The new set of correlations are valid for wall temperatures greater than 2400°R and extend from $P_w = 0.00001$ to 100.0 atm and from $h_T = 2000$ to 28,000 Btu/lb. The correlations are accurate to ± 10% throughout the majority of the region. (auth)

22863 (BNWL-1845-5) PACIFIC NORTHWEST LABORATORY MONTHLY REPORT ON SPACE NUCLEAR SYSTEMS PROGRAM FOR NOVEMBER 1974. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-1830. 21p. Dep. NTIS $4.00.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of ^{90}Sr if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term SrF_2 compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

22864 (CEA-N-1765) INCINERATION OF RADIOISOTOPIC HEART PACEMAKERS (SOURCES STO_1). Boucher, R.; Chicheportiche, A.; Pluchart, P.; Quillico, J. J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Oct 1974. 34p. (In French). Dep. NTIS (US Sales Only) $4.75.

New incineration tests have been undertaken in compliance with the latest specifications of the O.E.C.D. Nuclear Energy Agency (1300°C — 90 minutes — in air flow). New sources have been developed (version STO_1) triple clad and containing a fuel based on plutonium 238 oxide. Tests have been carried out on heart pacemakers conformable to the commercial model and containing sources of $^{238}PuO_2$ without pressure or UO_2 with internal helium pressure (lifetime 12 years). The tantalum outer cladding provides very efficient protection (against the action of the thermoelement bismuth telluride) and keeps the two inner claddings intact. (auth)

22865 (CEA-N-1772) BEHAVIOR OF ST SOURCES FOR RADIOISOTOPIC HEART PACEMAKERS UNDER THE PRESCRIBED FIRE-SIMULATION TEST. Boucher, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Nov 1974. 41p. (In French). Dep. NTIS (US Sales Only) $5.25.

Three different types of sources based on plutonium-238 were developed. The first (STA) contains a fuel based on $^{238}PuSc$ (0.16 g) and is double-clad. The second (STA') contains the same fuel and

is triple-clad. The third (STO_1) contains plutonium oxide and the same triple cladding as the STA' version. Results of various tests at 800°C show that the STA sources remain completely intact and do not leak. On the basis of previous results, tests on the resistance of STA sources to high internal pressures at 800 and 1,300°C, incineration tests at 1,300°C on pacemakers with STO_1 sources, it is shown that the STA' and STO_1 sources comply with the specifications of the O.E.C.D. Nuclear Energy Agency. (auth)

22866 (DPST-74-128-12) SAVANNAH RIVER LABORATORY MONTHLY REPORT: ^{238}Pu FUEL FORM PROCESSES. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Dec 1974. Contract AT(07-2)-1. 49p. Dep. NTIS $5.50.

PPO pellet fabrication studies showed that: shrinkage during post-hot-pressing heat treatment can be limited by increasing the shard heat treatment temperature; good shard-to-shard contacts are developed in hot-pressed $^{238}PuO_2$ if shards are heat treated at 1150°C or lower; and densities similar to results reported by LASL were obtained in pellets hot pressed at 5000 psi; densities 5 to 7% lower, but within PPO specifications, were obtained in pellets hot pressed at 3000 psi. Scanning electron microscopy studies showed a variation in particle morphology among $^{238}PuO_2$ powder lots produced a SRP from 1973 to 1974. Decontamination procedures using both electroplating and ultrasonic agitation techniques were shown to reduce $^{238}PuO_2$ contamination on Ir strips from 10^7 to about 100 alpha dis/min. Initial examination of oxalate-based (Savannah River Laboratory) and hydroxide-based (Mound Laboratory) Milliwatt shards indicates comparable density and surface area. Ultrasonic washing was demonstrated to be a candidate process for removing fines from shards in the Milliwatt Fuel Facility proposed for Savannah River. Networks of grain boundary gas bubbles due to helium agglomeration were observed in the microstructure of high density (>95%) Savannah River oxalate-based shards after aging at ambient temperatures for 8 months followed by heating at 1350°C and 1600°C. (auth)

22867 (MLM-1604) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY–MARCH 1969. (Mound Lab., Miamisburg, Ohio (USA)). 30 Apr 1969. Contract AT-33-1-GEN-53. 113p. Dep. NTIS $8.75.

Declassified 3 Mar 1975.

Progress in the isotopes fuel program during January to April 1969 is reported. Information is included on the preparation and characterization of ^{210}Po fuels and ^{238}Pu fuels, the compatibility of fuel materials with capsule materials, and capsule design, fabrication, and testing. (LCL)

22868 (PB-236212) RADIOISOTOPE POWERED ARTIFICIAL HEART PROGRAM. Final Report, 11 Jan 1971–30 Oct 1973, on Phase 1. Blair, M. G. (Arco Nuclear Co., Leechburg, Pa. (USA)). 15 Jan 1974. Contract N01-HL-2-2900. 355p. NTIS $10.00.

The purpose of this project has been to demonstrate the feasibility of a novel design concept for a self-contained total heart replacement device. The system, with a volume less than 1500 cc and weight less than 4 lb., is small and light enough for in-situ heart replacement. The design utilizes a cascaded thermoelectric-rankine cycle to convert heat energy from radioisotopic decay of ^{238}Pu into mechanical energy to directly drive a positive displacement blood pump. Control of the rankine cycle to meet physiological requirements is accomplished by an electronic-electromagnetic control system with appropriate inputs and logic. Sources of system inefficiency have been identified, and remedies suggested to improve system efficiency. (GRA)

22869 (SC-RR-64-2138) ANALYSIS AND TESTING OF RFD-2 CAPSULES IN SIMULATED RE-ENTRY. Marshall, B. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1965. Contract AT(29-1)-789. 41p. Dep. NTIS $5.50.

Declassified 3 Mar 1975.

Tests performed in the Martin Company 200-kilowatt hyperthermal arc-powered tunnel are described. Capsules representing the types to be used in the RFD-2 flight test were tested with the conditions shown. Included in the analyses of capsule performance are comparisons between behavior predicted by computer analysis and actual behavior at measured parameters. Calculations on the oxidation of the tantalum liners are presented. (auth)

22870 AVAILABILITY AND COST OF CURIUM-244 FROM POWER REACTOR FUEL REPROCESSING WASTES. Brown, P. E. (General Electric Co., Philadelphia); Lamb, E.; Albertson, D. G. pp 129-142 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

As a compact source of thermal energy, the radioisotope curium-244 has the advantages of high specific power, 2.8 W(t)-g^{-1} (pure ^{244}Cm), and long half-life, 18.12 y. The practical application of ^{244}Cm for the generation of electrical power in space depends on its availability and cost to the user. The operation of a nuclear/electric power generating station will yield ^{244}Cm as the product of six successive neutron captures in the uranium-238 which is the preponderant constituent of the nuclear reactor fuel. Projections of curium availability from the wastes generated in the reprocessing of typical LWR fuel cores through the General Electric Company–Midwest Fuel Recovery Plant and from other sources are given. The sensitivity of curium production to the level of fuel burnup and the effect on the quantity of curium produced, if plutonium-enriched uranium fuels are used is discussed. Based on the projected availability and the possible chemical flow sheets, probable costs for the recovery of raw ^{244}Cm are developed. To be useful in a heat source, ^{244}Cm must be available in chemical and physical forms that are well characterized. The problems associated with the fabrication and encapsulation of fuel in heat sources are examined. The status of curium isotopic fuel form development and heat source technology is reviewed. The probable costs of ^{244}Cm in a qualified heat source are derived from consideration of fuel form and heat source fabrication requirements. (auth)

22871 DESIGN OF A NUCLEAR ISOTOPE HEAT SOURCE ASSEMBLY FOR A SPACEBORNE MINI-BRAYTON POWER MODULE. Wein, D. (General Electric Co., Philadelphia); Gorland, S. H. pp 143-150 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Results of a Mini-Brayton Heat Source Assembly design study conducted by the General Electric Space Division under contract to the NASA-Lewis Research Center are presented. The objective of this study is to develop feasible design definition of a Heat Source Assembly (HSA) for use in nominal 500 W electrical (W_e), 1200 W_e or 2000 W_e Mini-Brayton spacecraft power systems. The HSA is a modular design which is used either as a single unit to provide thermal energy to the 500 W_e Mini-Brayton power module or in parallel with one or two additional HSA's for the 1200 W_e or 2000 W_e power module systems. Principal components consist of the Multi-Hundred Watt RTG Isotope Heat Source presently being developed by the Atomic Energy Commission, a Heat Source Heat Exchanger which transfers the thermal energy from the Heat Source to the Mini-Brayton power conversion system, an Auxiliary Cooling System which provides requisite cooling during nonoperation of the power conversion module and an Emergency Cooling System which precludes accidental release of isotope fuel in the event of system failure. The Heat Source Assembly is designed for a Space Shuttle mission. This requirement along with the multi-power capability impose a significant weight penalty on the HSA. (auth)

22872 NUCLEAR SAFETY CONSIDERATIONS FOR THE DESIGN OF A SHUTTLE LAUNCHED 500 TO 2000 WATT ISOTOPE BRAYTON POWER SYSTEM. Garate, J. A. (General Electric Co., Philadelphia); Gorland, S. H. pp 151-158 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The high efficiencies of the Brayton Power Conversion System promises to extend the application of plutonium-238 isotope systems in the kilowatt power range. From a safety viewpoint, an attractive feature of dynamic power conversion is that these high power levels can be achieved with much less fuel inventory than would be required for a system with static power conversion. An extensive study was conducted to evaluate the safety requirements for the design of a heat source assembly for use in a shuttle launched, isotope Brayton electric power system for the 500 to 2 kWe range. The assembly is a self-contained package which supplies heat to a power conversion system. Principal components include the Multi-Hundred Watt (MHW) Radioisotope Thermoelectric Generator Heat Source, a Heat Source Heat Exchanger, an Auxiliary Coolant Heat Exchanger, and an Emergency Cooling device. The MHW heat source is currently under development by the Atomic Energy Commission and is scheduled to fly in 1974. A typical mission profile for a shuttle launched, earth orbital mission was assumed. Critical mission accidents were identified and evaluated to determine their impact upon the design of the Heat Source Assembly. Earth-orbital decay reentry analyses were performed to demonstrate survivability of the heat source. Safety design requirements were developed to ensure survivability

under credible accident conditions including loss of the power conversion system in orbit. (auth)

22873 DESIGN OF A CURIUM-244 HEAT SOURCE FOR THE MULTI-HUNDRED WATT GENERATOR. Casagrande, R. D.; Garate, J. A. (General Electric Co., Philadelphia). pp 117-128 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A preliminary design concept of a 3200 W curium-244 heat source sized for the Multi-Hundred Watt Radioisotope Thermoelectric Generator is presented. The RTG utilizes 312 SiGe thermocouples, operates at a hot junction temperature of about 1000°C, and is designed to produce 193 W(e) at beginning of life and 125 W(e) after 5 y. The expected low cost and high power density of the curium-244 results in very desirable reductions in system cost and weight when compared to equivalent plutonium-238 fueled systems. The curium RTG specific cost is estimated to be about $4,900/W and will deliver 2.9 W/lb at beginning of life. This compares with a plutonium RTG specific cost of $16,000/W and a specific weight of 1.8 W/lb at beginning of life. The RTG heat source is designed for high temperature operation, intact reentry, and impact survival on granite at terminal velocities. A fuel pellet geometry was selected primarily to minimize post impact heat fluxes and because of the good existing technology for manufacture of the sesquioxide fuel in this form. (auth)

22874 GAS MANAGEMENT SYSTEM OF THE MHW HEAT SOURCE. Bunker, J. F. (General Electric Co., Philadelphia). pp 113-116 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The multi-hundred watt radioisotope thermoelectric generator (MHW-RTG) is designed to provide electrical power for various space flight applications in the 1970's. The thermal energy source for conversion is the alpha-emitting radioisotope ^{238}Pu. In the oxide form of PuO_2, this fuel is a helium generator by the neutralization of ionized alpha particles. The MHW heat source assembly (HSA) encapsulates the fuel in an impact shell and aeroshell to survive potential abort reentry and earth impact without creating a radiological hazard. To preclude high internal pressures and associated weight penalty and consequent reduction in impact capability, the heat source vents the generated helium outboard of the RTG. This high temperature system imposes the requirement for a non-oxidizing environment for the heat source internal components. The gas management system (GMS) of the MHW heat source provides means of controlling the HSA internal atmosphere. During ground handling and test operations up to the time of launch, the GMS provides a means of bleeding, evacuating, radiological and pressure monitoring, and otherwise management of the helium atmosphere within the HSA. The thin iridium can which provides the HSA gas containment is not designed to withstand high pressure. Therefore, prelaunch gas management must assure excessive pressure does not develop, while precluding oxygen back diffusion. After launch the GMS assures continuous venting of the heat source by a barometric switch. Included in the scope of the heat source gas management is the capability to maintain a slight helium pressure in the HSA throughout space operation. A pressure maintenance device maintains sufficient helium in the HSA to allow gas conduction heat transfer, resulting in lower operating temperatures. This capability is optional, and can be incorporated just prior to launch by attachment of a self-contained individual component at the extremity of the GMS vent tube. (auth)

22875 COMPATIBILITY OF THE MHW-RTG HEAT SOURCE MATERIALS. Pavone, D. (Los Alamos Scientific Lab., NM); Watrous, J. D.; Brown, P. E. pp 89-112 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The maximum operational temperatures which the MHW-RTG heat source must maintain and the possible thermochemical environments to which it may be subjected by accident, impose special requirements for compatibility among the heat source materials. The radioisotope fuel, ^{238}Pu is used in the form of the dioxide; the primary containment material is a shell of elemental iridium; an impact shell of carbon in the form of graphitized, impregnated fibers protects the primary containment from rupture in the case of accidental impact. The compatibility of these materials among themselves has been demonstrated by a series of tests at both operational and reentry temperatures. The test conditions imposed and the test results observed are reported. The data supporting the selection of the PuO_2 + Ir + C materials system, in preference to other candidates are presented. The status of additional confirmatory testing is given. (auth)

22876 MHW HSA REENTRY PERFORMANCE ANALYSIS. Quinn, J. E.; Knight, D. D. (General Electric Co., Philadelphia). pp 79-88 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The MHW (Multi Hundred Watt) is being developed for multi mission use for space applications in the 1970's. The HSA (Heat Source Assembly) must be designed to survive any potential mission aborts resulting in a reentry into the earth's atmosphere. This paper describes the analyses of the HSA performance during possible reentries. Areas discussed are: aerodynamics, flight motions, reentry heating, reentry shield ablation, thermal response of HSA internal components, thermal stresses in reentry shield and impact velocities. The analytical techniques employed are discussed along with the most significant results. In all cases examined, the MHW HSA is shown to survive the reentry and to impact at velocities equal to or below the impact velocity capability of the HSA. (auth)

22877 AEROTHERMAL TESTING OF THE MHW HEAT SOURCE. Knight, D. D.; Quinn, J. E. (General Electric Co., Philadelphia). pp 65-78 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The MHW radioisotope heat source has been designed to withstand a re-entry through the earth's atmosphere and the subsequent impact on the surface of the earth which may result due to mission abort. A series of engineering test programs have been run for the purpose of obtaining data required in the design of the re-entry protection, a graphite aeroshell. The tests include wind tunnel tests run to obtain the aerodynamic coefficients necessary for calculations of re-entry orientation, stability, and motion, tests to measure aerodynamic heating rates and distributions, hypersonic ablation tests run in an arc tunnel to determine aeroshell recession and shape change during simulated trajectories, ablation tests in subsonic flow to determine aeroshell heat and mass transfer characteristics prior to impact and drop tests to measure the heat source impact velocity. Each of these test programs is discussed in summary form giving test objectives, techniques, hardware, facility, results and conclusions. (auth)

22878 MHW HEAT SOURCE: AN ADVANCE IN RADIOISOTOPE HEAT SOURCE TECHNOLOGY FOR SPACE APPLICATIONS. Notestein, J. E. (General Electric Co., Philadelphia). pp 23-28 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The plutonium-238 fueled, heat source currently being developed as part of the Multi-Hundred Watt Radioisotope Thermoelectric Generator (MHW) program is described. This space electric power system requires a heat source to be capable of 2000°F operational temperatures and to offer improved safety for a spectrum of orbital and deep space missions. In addition, the heat source must also have attractive specific performance parameters, i.e., specific weight (lb/kWt) and specific volume ($in.^3$/kWt) to enable the system to realize the performance improvement potentials offered by an advanced silicon germanium thermoelectric converter. This 2400 W heat source is nominally 7.3 in. in dia, 16.7 in. long, and weighs 45 lb. The paper also compares the specific performance parameters of the MHW heat source with those of other space borne isotope heaters, i.e., Pioneer, SNAP-27, etc. (auth)

22879 ISOTOPE ORGANIC RANKINE CYCLE ELECTRIC POWER SYSTEMS FOR THE 150 TO 1500 WATT RANGE. Boretz, J. E. (TRW Systems Group, Redondo Beach, CA). pp 601-608 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A study was conducted to evaluate isotope organic Rankine cycle electric power systems in the 150 to 1500 W power range. Both conventional (turbogenerator only) and "hybrid" (cascaded thermoelectrics used in a "topping" manner) were considered. Depending upon the cycle conditions considered and the output power level, net system efficiencies of from 21 to 25% were calculated. The working fluids, thermoelectric elements, and cycle conditions are reviewed. In addition, the performance characteristics for both the "turbogenerator only" and "hybrid" systems are summarized. In a typical TRW Organic Cycle Electric Power System (ORCEPS), the dynamic energy conversion system consists of a ^{238}Pu isotope heat source, a turbopump-generator, boiler, regenerator, condenser-radiator and speed controls. In the "hybrid" system, both single stage silicon germanium or cascaded silicon germanium/lead telluride thermoelectric elements can be utilized. The static conversion system is designed to operate in a "topping" or "binary" mode with respect to the dynamic energy conversion system. Thus, after generating a portion of the total system electric power output in the thermoelectric elements, the heat rejected from this system provides the heat input to the boiler of the organic Rankine cycle energy conversion system. The electric power output from the thermoelectric stage is then combined with the output power from the turbogenerator unit. During the study a comparison was made between the TRW ORCEPS systems and the isotope-mini-Brayton and multi-hundred watt RTG systems. The study concludes that the TRW organic Rankine systems constitute very attractive candidates for any future MHW isotope electric power system applications. For a given power level they are the lightest of the three systems considered. They require considerably less isotope inventory than an equivalent MHW-RTG and utilize smaller radiator areas than the mini-Brayton system. In addition, various options are available to either reduce isotope inventory, reduce radiator area requirements or permit the use of lower surface temperature heat sources. This combination of high performance and system design flexibility makes the TRW ORCEPS systems compatible with a wide range of applications and can provide for commonality of usage by mission planners. (auth)

22880 DEVELOPMENT OF A THERMOCOMPRESSOR POWER SYSTEM FOR IMPLANTABLE ARTIFICIAL HEART APPLICATION. Moise, J. C.; Rudnicki, M. I.; Faeser, R. J. pp 511-535 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The current systems and recent developments in radioisotope-powered heart assist and total heart replacement systems are described. The power source is a 50 W ^{238}Pu capsule. The energy conversion system consists of a helium thermocompressor and a pneumatic actuation and control system which drives a H-TAH blood pump. Recent successful in vivo tests involving calves have demonstrated the adequacy of the simple all pneumatic control for the left ventricular assist system. Synchronization and 70% pressure relief of the left ventricle were provided over a wide range of physiological conditions, including over one hour operation during fibrillation of the natural heart with subsequent defibrillation. (auth)

22881 MODIFIED RANKINE CYCLE THERMAL ENGINE SYSTEM FOR CIRCULATORY SUPPORT. Blair, M. G. (Arco Nuclear Co., Leechburg, PA). pp 476-504 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Preliminary results of in-vitro testing of a modified rankine cycle thermal engine system are presented. The cascaded system utilizes a thermoelectric conversion topping stage to provide electrical energy for electronic control of both beat rate and stroke volume and for operation of a feedwater pump. The system design provides an engine that is small in size (380 cc) and light in weight (less than 2 lb), much of which reflects the weight of the radioisotopic source of heat. Characteristics of engine operation at rates from less than 30 BPM to 150 BPM against a variety of hydraulic loads at end-diastolic pressures up to 200 mmHg are presented. The effects of load compliance, stroke length, and beat rate on engine performance and efficiency are discussed. (auth)

22882 NUCLEAR FUELED CIRCULATORY SUPPORT SYSTEMS. VIII. Status of the Tidal Regenerator Engine System. Hagen, K. G. (Thermo Electron Corp., Waltham, MA); Ruggles, A. E.; Huffman, F. N.; Daley, B. D. T.; Migliore, J. J.; Norman, J. C. pp 468-475 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Development of a nuclear-powered implantable vapor cycle circulatory support system has progressed to the point of prolonged in vivo testing in animals. An electronically-controlled tidal regenerator engine is hydraulically coupled to a left ventricular assist pump which also functions as a blood-cooled heat exchanger. Control information is provided by a Hall sensor mounted on the pump and electric power is obtained by a thermoelectric module interposed between the engine and superheater. During the past year, significant progress has been made in reducing heat losses and extending system reliability. A recent system implant operated stably and continuously for 4½ days with a pumping rate of ~5 liters per minute. Counterpulsing with the biologic heart was maintained throughout the experiment and reduction of left ventricular pressure was demonstrated. A decrease in left ventricular wall motion was shown during prosthetic pumping. Serum hemoglobin levels remained below 10 mg%. (auth)

22883 SAFETY VERIFICATION OF A MINIATURE NUCLEAR BATTERY FOR CARDIAC PACEMAKERS. Postula, F. D. (Gulf Energy and Environmental Systems, Inc., San Diego, CA); Warner, E. E. pp 449-453 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Gulf Energy & Environmental Systems, under license from UKAEA Harwell, is producing miniature nuclear batteries for cardiac pacemakers. Extensive development and evaluation has been carried out in England and the U. S. for more than five years. Gulf has modified the original Harwell battery to include a heat source designed to withstand all credible accidents, including cremation, without loss of fuel. The fuel has been changed from PuN to PuO_2. The capsule structure, made from Ta-10W alloy, will contain the helium pressure for an infinite time and will survive all credible accidents. A clad of proprietary material has been developed to protect the structure during cremation from oxidation and chemical reaction with other battery components. This advanced heat source was developed at Donald W. Douglas Laboratories for Gulf. The capability of heat source to contain the ^{238}Pu has been verified by safety tests in accordance with USAEC guidelines. These are discussed in detail and consist of: (1) impact onto a granite surface at 50 m/s, (2) cremation simulation at 1300°C with the capsule pressurized in the complete battery, and (3) a sequence of exposures while pressurized at 150-year internal pressure to 800°C, followed by water quench and crushing under a 1000 kg load. (auth)

22884 STIRLING ENGINE APPROACH TO AN IMPLANTABLE NUCLEAR HEART-ASSIST SYSTEM. Feigenbutz, L. V. (McDonnell Douglas Corp.; Richland, WA); Griffith, W. R.; Hinderman, J. D.; Martini, W. R.; Perrone, R. E.; Gasper, K. A. pp 441-448 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A miniature engine based on the Stirling cycle has been designed, fabricated, and tested as a power source for an implantable artificial heart-assist device. The engine uses a 50 W plutonium-238 heat source or electric heat. On the bench, the engine has delivered the design output of 5.1 W hydraulic power with 50-W input. For in-vivo testing, hydraulic power is supplied to the left-ventricle-assist blood-pump actuator which uses hydraulic logic to control pump performance. The fully implanted system has provided complete synchronous relief for the left ventricle of the animal. A description of the system components is followed by in-vitro and in-vivo test results, a correlation of computer simulation and test results, and a projection of the growth potential of the system not only as a circulatory assist device, but as a full-heart replacement. (auth)

22885 COST-EFFECTIVE RADIOISOTOPE THERMOELECTRIC GENERATOR DESIGNS INVOLVING ^{244}Cm AND ^{238}Pu HEAT SOURCES. Eggers, P. E.; Ridihalgh, J. L. (Battelle Columbus Labs., OH). pp 13-20 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A comparative analysis of some of the technical considerations surrounding the use of ^{244}Cm and ^{238}Pu heat sources in radioisotope thermoelectric generators (RTG's) is presented. The principal considerations in this comparative analysis include radiological shielding, ground handling, and generator performance characteristics. The paper also describes a novel approach to RTG design and qualification which would facilitate the use of ^{244}Cm heat sources. This approach, which involves hermetically sealed bellows-encapsulated thermoelectric elements, also features the potential for increased generator output power stability and reliability and lower converter costs accruing from the advantages of a standardized approach to generator design, fabrication, and qualification. The results of preliminary experimental studies involving the bellows-encapsulated thermoelectric elements are also presented. (auth)

22886 ATMOSPHERE-ENTRY BEHAVIOR OF A MODULAR, DISK-SHAPED, ISOTOPE HEAT SOURCE. Vorreiter, J. W.; Burns, J. J.; Pitts, W. C.; Stine, H. A. (Ames Research Center, Moffett Field, CA). pp 1-8 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The entry and impact behavior of an isotope heat source for space nuclear power that disassembles into a number of modules that would enter the earth's atmosphere separately if a flight aborted were studied. These modules are disk-shaped units, each with its own reentry heat shield and protective impact container. In normal operation, the disk modules are stacked inside the generator, but during a reentry abort they separate and fly as individual units of low ballistic coefficient. Flight tests at hypersonic speeds have confirmed that a stack of disks will separate and assume a flat-forward mode of flight. Free-fall tests of single disks have demonstrated a nominal impact velocity of 30 m/s at sea level for a practical range of ballistic coefficients. Thermal and structural calculations indicate reentry survival under all possible reentry conditions for speeds up to and including earth escape speed. (auth)

Radiation Sources

Refer also to abstract 22683.

22887 CALIBRATION SOURCE EMITTING HIGH ENERGY BETA PARTICLES. Staples, B. A. (to Energy Research and Development Administration). US Patent 3,859,179. 7 Jan 1975. Filed date 15 Apr 1974. 4p.

A radiation source emitting high energy beta particles which is useful for film badge calibration is prepared by simultaneously electrodepositing nickel and ^{106}Ru onto a stainless steel disc, said ^{106}Ru being carried by natural ruthenium, washing the disc and electrodepositing nickel on the disc. (Official Gazette)

22888 THE APPLICATION OF LIQUID SCINTILLATION TECHNIQUES FOR DETERMINING LEAKAGES IN Ra-SOURCES. Reimschuessel, W.; Bem, H. (Politechnika Lodzka (Poland). Katedra Chemii Radiacyjnej). Postepy Fiz. Med.; 8: 15-22 (1973). (In Polish).

From third symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Liquid scintillation techniques have been evaluated in view of their use in determining leakages in Ra-sources. The sensitivity of the method, determined by the Covan and Nehemias criterion, is 0.5 pCi. (auth)

22889 A METHOD OF DETECTION AND QUANTITATIVE EVALUATION OF LEAKAGES IN Ra-SOURCES BY TRACE DETECTION. Mamont-Ciesla, K.; Biernacka, M.; Wasilewski, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). Postepy Fiz. Med.; 8: 7-13(1973). (In Polish).

From third symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Nine quantitative methods of estimating leakages in Ra sources have been compared. A trace detection method is described of detecting alpha radiation of Ra and its derivatives by means of a TRIAFOL foil. For the weighing bottle volume of 3×10^{-4} m^3 and the exposure time of 24 h the leakages of the order of 1 atom/s can be determined. (auth)

Design and Fabrication

22890 A 6 MeV GAMMA PHOTON FACILITY. Bishop, G. B. (Liverpool Univ. (UK). Dept. of Mechanical Engineering). Nucl. Instrum. Methods; 121: No. 3, 499-504(1 Nov 1974).

The ^{16}N radiation facility provides a source of 6 MeV gamma photons for shielding and dosimetry studies. It utilises the ^{16}N produced in the cooling water of the 300 kW Universities Research Reactor, Risley, as it flows through the fuel element assemblies. The facility incorporates a specially designed disc radiator providing an isotropic uniform disc source suitable for benchmark experiments. A shielded cell houses a lead collimator weighing 1.6 Mg which is capable of being moved in three directions by a traversing gear with external control and position indicator. (auth)

22891 RADIOACTIVE SOURCE PROJECTOR. Chassagne, D.; Delouche, G.; Fradin, J.; Rocoplan, J. A. (to Commissariat a l'Energie Atomique). US Patent 3,861,380. 21 Jan 1975. Priority date 28 Feb 1969, France. 6p.

A radioactive source projector for the treatment of cancerous lesions is described. The projector comprises, on the one hand, a projector unit containing a shield block and, on the other hand, ancillary means for displacing radioactive sources, said means being constituted by source-holders formed by a flexible metallic spring and each of which is intended to be applied at one end in the vicinity of the lesions, and to be joined to an actuating cable, each source holder being contained in a flexible tube secured to a flexible ejection sheath. (Official Gazette)

Industrial Uses

Refer also to abstracts 22795, 22941, and 22949.

22892 (AAEC/E-317) AUTORADIOGRAPHY OF RADIOACTIVE PHOTOGRAPHIC IMAGES: APPLICATIONS TO INTENSIFICATION, RESTORATION, PRECISION ETCHING, PHOTOMECHANICAL REPRODUCTION AND PHOTOGRAPHIC RESEARCH. Thackray, M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1974. 50p. Dep. NTIS (US Sales Only) $5.50.

Applications of nuclear science to photographic techniques are described. They are related to the observation that autoradiography of radioactive silver images confers three unique benefits on the process of photography: (1) information can be retrieved from a much smaller number of silver grains in a developed negative than is required using the transmission of visible light. This means that lower exposures are acceptable; (2) films used to record radiations of reasonable penetrating power (as in radiography with x-rays or neutrons) are no longer required to be transparent. This permits a much wider selection of materials for use in their fabrication; and (3) photographs toned with isotopes which emit densely ionizing radiation will produce a radiation damage pattern in any surface which contacts them. In many such surfaces, etching techniques can reproduce the photograph as a high fidelity intaglio image. Such etchings can provide much more faithful relief reproductions of the photograph than were possible by previous methods. Experimental work is described on the application of these principles to the intensification of underexposed and faded photographs, to precision etching and to the multiple reproduction of photographs by printing. A literature survey is also included, together with some speculation on the possible future interactions between nuclear science and photography. (auth)

22893 (AD-786539) DEVELOPMENT OF IRRADIATED BEEF. II. Effects of Irradiation Temperature and Dose on the Quality of Roast Beef. Shults, G. W.; Wierbicki, E. (Army Natick Labs., Mass. (USA)). Jul 1974. 28p. (FL-181; USA-NLABS-TR-74-56-FL). NTIS $3.75.

A reduction of irradiation temperature to –80°C at 4.5 mega rads was sufficient to produce an acceptable irradiated beef roast, when using choice graded beef rounds, chuck and commercial graded loins on the basic raw materials. A comparison of rating for sensory characteristics and preference showed no statistical difference over a one year storage period, except the ratings for mushiness were significantly higher for the knuckle section. Beef irradiated at the 12-D sterilizing doses (4.7 megarads at –30°C or 5.7 megarads at –80°C) yielded products with high intensity scores for the sensory characteristics and relatively low preference ratings. Beef irradiated at the 12-D doses is of lower quality than beef irradiated at lower temperatures. (auth)

22894 (AD-786540) DEVELOPMENT OF IRRADIATED BEEF. I. Acceptance of Beef Loin Irradiated at Cryogenic Temperatures. Shults, G. W.; Wierbicki, E. (Army Natick Labs., Mass. (USA)). Jul 1974. 21p. (FL-182; USA-NLABS-TR-74-57-FL). NTIS $3.25.

U. S. choice beef loin stored for one year showed no difference in the ratings of samples irradiated at –80, –120, and 185°C when evaluated for sensory characteristics and preference by a technological (expert) panel. Consumer type panelists could not detect

any difference in the irradiated samples that could be attributed to the temperatures of irradiation within the temperature range from –40 to –185°C. Results of technological panel evaluations obtained for the sensory characteristics of U. S. commercial beef loin stored for one year showed statistical differences between the –40 and –80°C samples and the non-irradiated controls. No differences were noted in the sensory characteristics and preference ratings of samples irradiated at –120 and –185°C. (auth)

22895 (IEA-344) OCEAN DISPOSAL SYSTEM FOR SEWAGE OF SANTOS AND SAO VICENTE. Part 4. Bacterial Mortality. Agudo, E. G.; Occhipinti, A. G.; Sanchez, W.; Gaglianone, S. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jun 1974. 40p. (In Portuguese). Dep. NTIS (US Sales Only) $5.00.

Oceanographic studies were performed at the sewage outlet from Santos-São Vicente cities, in order to determine the T_{90} values for the die away of bacterias. Forty-two oceanographic surveys were carried out, over a period of two years, using two different techniques. The first consisted in an instantaneous injection of a radioactive tracer (^{82}Br), for the identification of the collections from the sea. Physical dilution was measured by soluble phosphate concentrations. The second technique consisted in the continuous injection of the radioactive tracer, over a period of 2.5 h, measuring the physical dilution with the bromide and phosphate concentrations. Specially designed small floats were used for identification of the collecting points. A statistical study of the results showed a good agreement between both methods. In several surveys, tests with dializers were also simultaneously performed, at the same place, in order to compare the results. A statistical study showed no correlation between the results from dializers and the "in situ" tracing technique. (auth)

22896 (IEA-345) RADIOISOTOPE TECHNIQUE APPLIED TO THE STUDY OF THE WEAR OF TUNGSTEN CARBIDE CUTTING TOOLS. El Thawil, M.; Sanchez, W. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jun 1974. 17p. (In Portuguese). Dep. NTIS (US Sales Only) $4.00.

The cutting of metals by tungsten carbide tools is one of the most important forms of metal processing, therefore, the tool wear rate of three different sintered tungsten carbide tools: TX(P-25), NTA(P-30) and T-108 was studied. The sequence of operations during the tests was as follows: approximately fifty grams of chips were removed from the workpiece by a cutting tool previously irradiated in the IEAR-1 reactor. In each cut the chips were collected, separated in 10 samples, weighing 4.52 ± 0.03 g each, and then their radioactivity was counted. The mean value of the 10 samples is representative of the tool wear in the specific cutting condition. The tools wear rate was determined by comparing the activity of the chip samples with that of a standard. The cutting time was varied according to the test conditions, i.e., velocity, cutting depth, feed, cutting fluids, and rake angle. The workpiece material was steel, with cylindrical geometry (ϕ = 240 mm and H = 200 mm) and the following grades were machined: SAE-1020, SAE-1030, SAE-1040, and SAE-1050. The experimental results show that the tool TX(P-25) must be used in the machining of SAE-1050 steel parts and the tools NTA(P-30) and T-108 in the processing of SAE-1020 and SAE-1030 steel parts. (auth)

22897 (JAERI-M-5610) SHALLOW IRRADIATION OF THE VIENNA SAUSAGE BY ELECTRON-RAYS IN PREVENTATION OF THE SLIME PRODUCTION. Watanabe, H.; Sunaga, H.; Kume, T.; Ito, H.; Aoki, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 18p. (In Japanese). Dep. NTIS (US Sales Only).

Vienna sausages are spoiled by slime production or putrefaction due to the propagation of microorganisms when stored only for 3 to 5 days at a storage temperature of 10°C. The radiation pasturization for prevention of the slime production or putrefaction of vienna sausages has mainly been studied with gamma irradiation. The slime of sausages is believed to be microorganisms themselves growing on the surface of sausages. Pasteurization of the surface of vienna sausages with electron irradiation was thus investigated. The results obtained were as follows: the vienna sausages irradiated to a dose of 0.8 to 1.0 Mrad with 0.5 MeV electrons can be stored without slime production or putrefaction for more than a week at 10°C; the effect of pasteurization increases with energy and dose of the electrons; changes in the organoleptic qualities of vienna sausages are observable when irradiated to a dose of over 0.7 Mrad with 2.0 MeV electrons; and irradiation to a dose of 1.0 Mrad with 1.0 MeV electrons is effectual in lengthening their shelf-life without deterioration of the organoleptic qualities. (auth)

22898 (JAERI-M-5772) STUDIES ON THE OFF-FLAVOR OF VIENNA SAUSAGE IRRADIATED WITH GAMMA RAYS. Watanabe, H.; Aoki, S.; Sato, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 13p. (In Japanese). Dep. NTIS (US Sales Only).

Studies of the vienna sausage off-flavor were made to detect the organic compounds responsible for the characteristic unpleasant odor of vienna sausage treated by gamma radiation. The amounts of volatile sulfur compounds are little influenced by irradiation, so the changes in volatile bases, alcohols and carbonyl compounds in sausages were investigated. When the sausages were irradiated to a dose of up to 1.0 Mrad, no changes were observed in the amounts of total volatile bases. Therefore, it was found that the total volatile bases play a small role in occurrence of the odor. The unpleasant odor in head space vapor of irradiated sausages was collected in the trap cooled with a NaCl-ice mixture. Gas-chromatography analysis using a capillary column of the compounds in this trap revealed that the unpleasant odor is a mixture of various volatile components, and consisted mainly of alcohols and carbonyl compounds. (auth)

22899 (JAERI-M-5787) RADIATION PRESERVATION OF VIENNA SAUSAGE. I. Dose Distribution of Vienna Sausage on Package Irradiation. Kume, T.; Aoki, S.; Ito, H.; Watanabe, H.; Sato, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 11p. (In Japanese). Dep. NTIS (US Sales Only).

The gamma irradiation of vienna sausages was investigated in extending their shelf-life. Package irradiation is suitable for irradiation of vienna sausages in large quantity; however unevenness of dose in the irradiation occurs. The dose distribution in a 20 × 30 × 30 cm package of vienna sausages (ρ = 0.27g/cm^3) was measured with a Fricke or PMMA dosimeter, to examine the irradiation conditions for reducing the unevenness. Four packages of wholesomeness test vienna sausages were placed in parallel with source rod, and irradiated at the 5×10^5R/hr dose position for 1 h with inversion at 30 min. The dose uniformity in this 10 × 30 × 30 cm package was found to be 1.26. The uneveness in the y direction (horizontal) was very small. The variation in exposure in the z direction (vertical) contributed largely to the overall unevenness. The unevenness in the z direction decreased by alteration of the specific activity ratio in this direction of the source rod. The unevenness in the x direction (depth) can be decreased by irradiation at a low dose rate using the high activity source. The dose uniformity in the 20 × 30 × 30 cm package was 1.13 at a dose rate of 1.7×10^5R/hr with the 140,000 Ci source. (auth)

22900 (NRPB-R-28) USE OF PLUTONIUM-239 SOURCES IN SCHOOLS AND OTHER EDUCATIONAL ESTABLISHMENTS. Williams, T. G. (National Radiological Protection Board, Harwell (UK)). Aug 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The safety and suitability of sealed radioactive sources used in educational establishments, with special reference to the use of ^{239}Pu was investigated. Sources in schools in the Leeds and Glasgow areas were tested for leakage. Sources obtained direct from the manufacturers were also tested under conditions that might result from the possible misuse or accidental damage of the sources. It was concluded that the properties of Pu sources issued to schools and other educational establishments and the arrangements for their use are such that the demonstrations and experiments can be carried out with a very high degree of safety. The series of tests indicated no previously unconsidered radiological problems arising from the use of these sources. Recommendations have been made for extending the Science Teacher Courses to cover details concerning the construction of radioactive sources used in schools and more information on the radiotoxicity of the radioactive materials most commonly used; also for ensuring that each Education Department maintains a more effective central registry for sources held in its educational establishments. (auth)

22901 PNEUMATIC DEVICES IN ISOTOPE TECHNOLOGY. II. Egri, B.; Csoke, A. (Kozponti Fizikai Kutato Intezete, Budapest). Izotoptechnika; 17: No. 12, 563-577 (Dec 1974). (In Hungarian).

Topics discussed include pneumatic logical units, contacts without moving parts, level indicators, program controllers, and high pressure systems. (auth)

22902 POOL LABORATORY IRRADIATION FACILITY. Herrnhut, H.; Latzer, B. (Sulzer Bros. Ltd., Winterthur, Switzerland). Sulzer Tech. Rev.; No. 1974, 3-5(1974).

Ionizing radiation is exploited in a variety of areas, such as medicine, biology, and chemistry. New processes must be tested before application, to ensure that the methods will be successful in use. Two examples are the hygienization and sterilization processes, which are already being used industrially. The "Pool" gamma irradiation unit was developed to provide research with a testing facility of this kind. It is a laboratory unit with a particularly flexible source configuration. With this plant, it is possible to irradiate spaces, enabling the use of gamma irradiation in the various fields of research to be subjected to critical appraisal. (auth)

22903 METODIKA TEKHNIKO-EKONOMICHESKOGO ANALIZA PRIMENENIYA RADIOIZOTOPNYKH SREDSTV KONTROLYA V TEKHNIKE. (Methods for the Technical and Economic Analysis of the Use of Radioisotopic Control Methods in Industry). Akopov, V. S.; Mymrin, Yu. N.; Postnikov, V. I. Moscow; Atomizdat (1974). 200p.

Methods are given for technico-economic analysis of the use of radioisotopic techniques for control in technological processes. Indexes used in carrying out an analysis, methods for determining them, and factors affecting them are discussed. The results of technico-economic studies carried out in the development and introduction of new radioisotopic methods for control of resistance to wear and the quality of machine parts and units are presented. Relations are given which permit engineers, technological workers, and economists to use them as the basis for developing promising leads in designing new techniques. The book is designed for scientific workers, construction people, and technologists who are concerned with using radioisotopic control methods in production operations. It may be used by technical school students. (tr-auth)

22904 THE USE OF YTTRIUM AND SCANDIUM FOR FABRICATION OF RADIOACTIVE ELECTRON EMITTERS. Singleton, J.H.; Yannopoulos, L.N. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Vac. Sci. Technol. 12: No. 1, 414-418 (Jan 1975).

Thin films of titanium tritide are widely used as a radioactive source of electrons of average energy ~5.7 keV. Because of the limited thermal stability of this tritide, such films can only be exposed to temperatures above 200°C for very short time intervals during processing or operation. The production of emitters which can be used at temperatures 100–150°C higher than those using titanium is described. The films of yttrium and scandium, of thickness 5000–12000 Å, on stainless steel substrates, contain in excess of one tritium per metal atom and yield stable electron densities of $1-2\times10^{-10}$ A/cm^2. The films have good adhesion and resist abrasion; they can be sheared to a desired size either before or after loading with tritium. The thermal stability of the electron emitters in vacuum, hydrogen, and a hydrogen–nitrogen mixture has been determined. The data illustrate the profound influence of surface contamination on both the loading and loss of tritium in the films. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 22117 and 23016.

22905 (AED-CONF-74-440-005) RADICAL FORMATION IN N-ACETYL-DL-VALINE DISSOLVED IN WATER UNDER THE EFFECT OF GAMMA AND uv IRRADIATION AT 77 K. Schnepel, G. H.; Neubacher, H. (Giessen Univ. (F. R. Germany). Inst. fuer Biophysik). 1974. 5p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e. V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

Following x-ray irradiation of monocrystals of N-acetyl-DL-valine $(CH_3)_2CHCH(COOH)NHCOCH_3$, the structures $(CH_3)_2C$(-Radical-)$CH(COOH)NHCOCH_3$ and $(CH_3)_2C$(-Radical-)CH_2COOH could be determined. The ESR spectroscopy of polycrystalline samples after irradiation and measuring at 77°K showed that both types of radicals are secondary radicals in the chain of radiation-induced reactions. N-acetyl-DL-valine dissolved in water was γ-irradiated at 77°K and then at the same temperature, exposed to uv light having a wavelength greater than 300 nm. The formation of the methyl radical CH_3 could be seen in the ESR spectrum. It is probably small enough to remain free to move even in solid solutions. This radical, besides other paramagnetic centres, is observed even after sole uv irradiation, however only in considerably lower concentration than after previous γ irradiation. (GE)

22906 (AED-CONF-74-440-007) THE RADIOLYSIS OF RIBONUCLEASE IN THE PRESENCE OF RADICAL SCAVENGERS. Schuessler, H. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Inst. fuer Physikalische und Medizinische Strahlenkunde). 1974. 5p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e. V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974). Available from ZAED.

The irradiation of ribonuclease was carried out in the presence of radical scavengers in order to decide the question of which primary radicals of water radiolysis bring about the inactivation of ribonuclease. Ethanol was used to trap the OH radicals. The reaction of the solvated electrons with ribonuclease could be prevented by N_2O. The measurement of the D_{37} as a function of the enzyme concentration under these conditions showed that ethanol gave rise to a radiation protection for the whole concentration region investigated, whereas in the presence of N_2O, a decrease of the radiation inactivation could only be measured at low concentrations. At concentrations over 10^{-4} M ribonuclease, a larger radiosensitivity was found with N_2O saturation. This behavior could be observed for both enzymatic functions of ribonuclease. Further investigations by means of gel filtration and amino acid analysis showed that the radical scavengers bring about different reaction mechanisms and that it is probable that there is an interaction between enzyme molecules and radical scavengers. (GE)

22907 (N-74-31569) [RESEARCH PROGRESS IN RADIATION DETECTORS, PATTERN RECOGNITION PROGRAMS, AND RADIATION DAMAGE DETERMINATION IN DNA]. Final Report, 1 October 1972–31 October 1973. Baily, N. A. (California Univ., San Diego (USA)). 31 Oct 1974. 17p. (NASA-CR-139664). NTIS $4.00.

The radiological implications of statistical variations in energy deposition by ionizing radiation were investigated in the conduct of the following experiments: study of the production of secondary particles generated by the passage of the primary radiation through bone and muscle; the study of the ratio of nonreparable to reparable damage in DNA as a function of different energy deposition patterns generated by x rays versus heavy fast charged particles; the use of electronic radiography systems for direct fluoroscopic tomography and for the synthesis of multiple planes; and the determination of the characteristics of systems response to split fields having different contrast levels, and of minimum detectable contrast levels between the halves under realistic clinical situations. (STAR)

22908 RADIATION-INDUCED SINGLE-STRAND BREAKS IN DNA DETERMINED BY RATE OF ALKALINE STRAND SEPARATION AND HYDROXYLAPATITE CHROMATOGRAPHY: AN ALTERNATIVE TO VELOCITY SEDIMENTATION. Ahnstroem, G.; Edvardsson, K. A. (Univ. of Stockholm). Int. J. Radiat. Biol.; 26: No. 5, 493-497 (Nov 1974).

A simple technique is described for studying the induction and repair of strand breaks in DNA from mammalian cells. The method was based on the principle that single-strand breaks serve as untwisting points during strand separation in alkaline solution, and that DNA, for a time-limited treatment in alkali, is transformed into single-stranded form in proportion to the number of strand breaks present initially. Irradiated Chinese hamster cells were treated with alkali for a fixed period at constant temperature in the dark, the alkali (0.02 to 0.03M) acting as a lysing agent as well as inducing strand separation. After neutralization followed by a short ultra-sound treatment, single- and double-stranded DNA were separated by means of hydroxylapatite chromatography. The percentage of single-stranded DNA formed by alkali treatment was related to the number of strand breaks by comparison with the velocity sedimentation of DNA from hamster cells, irradiated under the same conditions as those cells used for rate of strand separation. The mechanisms of DNA strand separation and renaturation during alkali treatment of mammalian DNA are discussed. (UK)

22909 RADIOSENSITIZATION OF LYSOZYME BY DYE BINDING. Tien, F. T.; Grossweiner, L. I.; Kepka, A. G. (Illinois Inst. of Tech., Chicago). Int. J. Radiat. Biol.; 26: No. 4, 405-407 (Oct 1974).

The complexing of eosin to lysozyme was studied in an investigation of the possible effects of the complexing of radiosensitizers on damage pathways. Irradiations were performed on Worthington hen egg-white lysozyme and chromatographically purified eosin in 2 mM, pH 7.0 phosphate buffer, using 25-MeV electrons from a linear accelerator at 2.5 krads/min. The results showed that the sensitivity of lysozyme to the inactivating attack of $OH^{\cdot}$ and $(CNS)_2^{-\cdot}$ was enhanced by complexing of eosin without significantly increasing the overall reactivity towards those radicals. It is suggested that the complexing of a sensitizing or protective agent to biomolecules may be a significant factor in its function as a mediator of radiological response. Possible mechanisms of the effect are discussed. (UK)

22910 PRIMARY AND SECONDARY RADICALS IN THE RADIATION-INDUCED INACTIVATION OF YEAST ALCOHOLDEHYDROGENASE. Badiello, R.; Tamba, M.; Quintiliani, M. (Consiglio Nazionale delle Ricerche, Bologna). Int. J. Radiat. Biol.; 26: No. 4, 311-319 (Oct 1974).

Radiation inactivation of YADH in dilute aqueous solution that did not contain oxygen was due to H atoms and OH radicals, whose inactivating efficiencies were in the ratio 9:1. The same species were responsible for the transient absorption arising in pulse-irradiated YADH in the region of 300 to 320 nm, and in this case their relative efficiencies were 7.5 to 1. This resulted from steady-state and pulse radiolysis experiments using radical scavengers such as t-butanol, formate and N_2O. It appeared that oxygen, when present, may have also contributed to the enzyme inactivation through its radiation-induced radicals. Secondary radicals originated by reaction of OH radicals with CNS^-, Br^-, and I^-, all inactivated the enzyme at a faster rate than their primary parent radical. Their relative inactivating efficiencies were of the same order as their rate constants for reaction with YADH. (auth)

22911 STUDY OF CHANGES IN DNA CONFORMATION CAUSED BY IONIZING AND ULTRA-VIOLET RADIATION BY MEANS OF PULSE POLAROGRAPHY AND CIRCULAR DICHROISM. Vorlockova, M.; Palecek, E. (Ceskoslovenska Akademie Ved. Brno). Int. J. Radiat. Biol.; 26: No. 4, 363-372 (Oct 1974).

The changes in the secondary structure of DNA caused by ionizing and uv-radiations were studied by means of circular dichroism and differential pulse polarography. An application of relatively low doses of radiation (of the order of 10^4 rads or 10^4 erg mm^{-2}) caused an increase of the polarographic reducibility of DNA and an increase of the positive CD band in the vicinity of 275 nm. Doses by one order of magnitude higher brought about a decrease of ellipticity at 275 nm and simultaneously a shift of the pulse-polarographic peak to negative potential values (nearer to the potential of the reduction of the denatured DNA). Irradiation of DNA with low doses of γ- and uv-radiation probably induces local changes in angles and distances between the bases in the double helix. No single-stranded fragments are formed. Denatured DNA appeared after irradiating DNA with higher doses of ionizing radiation, or after heating the irradiated samples to a temperature below melting-point. (UK)

22912 DIFFERENTIAL SENSITIVITY OF DNA STRAND-BREAK-REJOINING MECHANISMS TO SPLIT DOSES OF X RAYS. Wheeler, K. T.; Linn, J. D. (Univ. of California, San Francisco). Int. J. Radiat. Biol.; 26: No. 5, 411-420 (Nov 1974).

Stages in the initiation and operation of the DNA rejoining mechanisms in rat brain-tumor cells were isolated by irradiating

the cells with 6 krads of x rays. A second 6-krad dose delivered 10 min after the first caused accumulation of more residual DNA damage after both short and long post-irradiation incubation times than did a single 12-krad dose. At this time single-strand-break rejoining was nearly complete, and both a degradative and a second rejoining process were beginning. When the second 6-krad dose was delivered after longer post-irradiation intervals, less damage than that inflicted by a single 12-krad dose was observed. These results indicate that there is a radiosensitive period during the DNA rejoining process in rat brain-tumor cells. (auth)

22913 RADIATION-INDUCED CROSS-LINKING OF α-CHYMOTRYPSIN TO DNA AND AGAROSE GEL. Kasche, V. (Uppsala Univ.). Int. J. Radiat. Biol.; 26: No. 5, 455-465 (Nov 1974).

Radioinduced crosslinking of the enzyme α-chymotrypsin (CT) to an agarose gel (Sepharose) and DNA was studied. Crosslinking to DNA was found to occur readily with CT-radicals formed from native CT. With Sepharose mainly CT-radicals formed from radiation-modified CT were involved in the crosslinking reaction. The G-value for crosslinking of CT to DNA was 10 to 30 per cent of the corresponding values for single-strand breaks in in vitro-systems. The results indicated that many DNA radicals produced in vitro or in vivo were terminated in crosslinking processes. The biological consequences of these processes depend on the existence of repair mechanisms for different kind of crosslinks. It is proposed that radiation-induced crosslinking with DNA is a more sensitive index for radiation damage than change in molecular weight. (auth)

22914 STUDIES ON IRRADIATION OF AGAR–AGAR IN THE SOLID STATE: ON THE CHANGES OF VISCOSITY OF AGAR–AGAR HYDROSOL PRODUCED BY IRRADIATION. Nisizawa, M. (Defense Academy, Yokosuka, Kansagawa, Japan). Radiat. Eff.; 23: No. 1, 43-47 (Sep 1974).

The effects of radiation on the formation of the agar-agar hydrosol were studied by measuring the viscosity changes at different radiation doses and concentrations of added substances (sugar and starch). The experimental equations for the viscosity changes are given by (a) $\eta_{red} = a(\log X)^2 + b(\log X) + c$; (b) $\eta_{red} = b - a \log t$; and (c) $\eta_{red} = b - a \log S$; where η_{red} is the reduced viscosity of the agar-agar hydrosol, X is the radiation dose, t is the elapsed time after irradiation, S is the concentration of the added substances, and a, b, and c are adjustable constants. (auth)

22915 ULTRAVIOLET AND N-FORMYL-KYNURENINE-SENSITIZED PHOTOINACTIVATION OF BOVINE CARBONIC ANHYDRASE. An Internal Photodynamic Effect. Walrant, P.; Santus, R. (Museum National d'Histoire Naturelle, Paris). Photochem. Photobiol.; 20: No. 5, 455-460 (Nov 1974).

Direct photoinactivation by uv light of bovine carbonic anhydrase, as well as its photosensitization by N-formyl-kynurenine, a tryptophan photooxidation product, have been investigated. In the presence of oxygen, both methods led to similar results: the enzyme lost its activity, the tryptophanyl, histidyl and, to a lesser extent, tyrosyl residues having been destroyed. In nitrogen-saturated solutions, a dramatic drop was observed in the photoinactivation yield under the direct action of ultraviolet light, whereas histidyl residues remained intact. Evidence indicated an internal photodynamic action of N-formyl-kynurenine in the protein core produced by the uv photooxidation of tryptophanyl residues. Photoinactivation of oxygenated enzyme solutions by external and internal photodynamic action correlated with histidyl residue destruction via singlet oxygen. The possible importance of the photodynamic ability of N-formyl-kynurenine in the photochemistry of proteins, DNA, and cells is discussed. (auth)

22916 INTERACTION BETWEEN CAFFEINE AND NUCLEIC ACIDS. IV. The Influence of Caffeine on the Photodimerization in DNA. Lang, H. (Central Inst. for Mikrobiology and Experimental Therapy, Jena, Ger.). Stud. Biophys.; 45: 145-155 (1974).

Taking as a basis the assumption of SINANOGLU and ABDULNAR/17/ that the photodimerization of DNA depends to a great extent on the stacking forces between the neighboring bases, the influence of caffeine on the dimerization after irradiation with 254 nm uv-light is investigated. Since the stacking interaction is supported by the interaction between caffeine and DNA occurring in conjunction with binding process I, it was to be expected that the presence of caffeine in DNA solution effects the photodimerization. As shown by the drop of relative absorbance at 270 nm, as well as by CD and T_m measurements, an increase in the dimerization rate is observed caused by caffeine up to $3 \cdot 10^{-6}$ M. The results are in accordance with the conclusions drawn by TRAMER et al./18/. (auth)

22917 SEDIMENTATION STUDIES OF IONIZING RADIATION DAMAGE IN MAMMALIAN DNA. Palcic, B. Hamilton, Ont.; McMaster Univ. (1972). 146p.

Thesis.

The production of single strand breaks by ionizing radiation (γ-rays) in mammalian cell DNA was studied by a modified method of alkaline sucrose gradients. The effect of molecular oxygen and 2,4-dinitrophenol on the yield of single strand breaks was examined and the results are reported in this thesis. Also, subsequent rejoining of single strand breaks was studied. (auth)

Radiation Effects on Cells

Refer also to abstract 23026.

22918 RBE OF ^{60}Co GAMMA RAYS WITH RESPECT TO 300 kVp X-RAYS FOR THE SURVIVAL OF HeLa S–3 AND CHO CELLS, IRRADIATED IN DIFFERENT STATES OF PROLIFERATION. Malone, J. F.; Porter, D.; Hendry, J. H. (Dept. of Clinical Physics and Bioengineering, Glasgow). Int. J. Radiat. Biol.; 26: No. 4, 355-362 (Oct 1974).

The RBE of ^{60}Co radiation with respect to 300 kVp x rays was measured in two cell-lines whose normal rates of proliferation varied by a factor of 2, and values were also obtained in stationary-phase cultures. No significant influence of proliferation rate on RBE was observed, in contrast to a previous finding in bone-marrow. (auth)

22919 ENHANCEMENT OF THE RADIOPROTECTIVE EFFECTS OF 2-MERCAPTOETHYLAMINE ON COLONY-FORMING CELLS BY AGENTS WHICH ALTER CYCLIC NUCLEOTIDE LEVELS. Pazdernik, T. L.; Uyeki, E. M. (Univ. of Kansas, Kansas City). Int. J. Radiat. Biol.; 26: No. 4, 331-340 (Oct 1974).

The development of colony-forming cells (CFC) in vitro from 1×10^5 BDF_1 mouse bone-marrow cells was markedly inhibited by exposing bone-marrow cells to x-irradiation before plating. The degree of inhibition was dependent on the dose of radiation; a reduction greater than 90% occurring in the number of CFC in the group irradiated with 600 R. The addition of 33 mM 2-mercaptoethylamine (MEA) before radiation increased the number of CFC obtained in the irradiated group, whereas no protection occurred if MEA was added after irradiation. The radioprotective effects of MEA were significantly enhanced by incubating the cells for 1 hour before addition of MEA with agents known to alter cyclic nucleotide levels. These agents include 10^{-4}M isoproterenol, 10^{-4}M theophylline, 10^{-7}M imidazole, 10^{-3} to 10^{-5}M cyclic-3′,5′-adenosine monophosphate, 10^{-4}M cyclic 3′,5′-guanosine monophosphate and 10 μg/ml PGE_1. These results suggested that the levels of cyclic nucleotides are important in radioprotection. (auth)

22920 DUAL EFFECT OF OXYGEN ON THE INDUCTION AND REPAIR OF SINGLE-STRAND BREAKS IN THE DNA OF X-IRRADIATED MAMMALIAN CELLS. Modig, H. G.; Edgren, M.; Revesz, L. Int. J. Radiat. Biol.; 26: No. 4, 341-353 (Oct 1974).

The induction and rejoining of single-strand DNA breaks was studied in Chinese hamster cells exposed to radiation under oxic or anoxic conditions. The number of breaks was determined by the alkaline sucrose gradient technique either immediately after irradiation or after a period of oxic or extremely hypoxic incubation. A linear relationship between the dose and the inverse of the molecular weight of irradiated DNA was noted when oxygen was present or absent during radiation exposure. A dose-modifying effect of oxygen by a factor 2.3 was calculated. When quinacrine was used to inhibit rejoining of breaks during irradiation, the dose-modifying factor increased to 2.7. The energy required to induce one single-strand break was estimated to be 29 eV in oxygen, and 77 eV in anoxia. When the cells were incubated after irradiation under oxic conditions for 30 min, about 80 per cent of the oxically-induced breaks, and about 50 per cent of the hypoxically-induced breaks were repaired. The rejoining process was greatly inhibited when post-irradiation incubation was made under anoxic conditions. In this case, not more than 10 to 20 percent of the breaks were repaired independently whether exposure to radiation was made in the presence or absence of oxygen. (auth)

22921 MODEL OF GROWTH KINETICS OF IRRADIATED CULTURED CELLS. Okumura, Y.; Uchiyama, Y. (Aichi Cancer Center, Nagoya, Japan). Int. J. Radiat. Biol.; 26: No. 4, 321-330 (Oct 1974).

The growth of rapidly-growing cultured cells was altered from exponential growth by x-irradiation. The irradiated cell-population was composed of two kinds of cells; surviving and non-surviving cells. Surviving cells which retained their reproductive capacity might have proliferated indefinitely after recovery of division delay. Non-surviving cells, which failed to retain their reproductive capacity lost the ability to divide gradually with time and died. The effects of radiation affecting growth curves may have been due to loss of reproductive capacity, division delay, loss of the ability to divide and cell-death. A model of the growth kinetics of irradiated cells is presented which takes into account these radiation

effects, and was used for the analysis of growth curves. Experimentally obtained growth curves of irradiated cultured mammalian cells were compared with the growth curves calculated and based on the model, and the manifestation of radiation damage is discussed. (auth)

22922 FREQUENCY AND DISTRIBUTION OF ISOLABELLING IN CHINESE HAMSTER CHROMOSOMES AFTER EXPOSURE TO X RAYS. Gatti, M.; Pimpinelli, S.; Olivieri, G. (Univ., Rome). Mutat. Res.; 23: No. 2, 229-238(May 1974).

Two experiments were carried out, following the same scheme. Chinese hamster cells were cultivated for 4 h in the presence of tritiated thymidine. After removal of the isotope, some of the cultures were x-irradiated in stage S-G_2 preceding M_1, others in stage S-G_2 preceding M_2. Analysis of the colchicine-C-anaphase of M_2 cells showed that in both experiments the x-rays produced an increase in the isolabelling regions only if given in the S-G_2 stage preceding M_1. On the other hand, the x rays produced an increase in sister chromatid exchanges (SCEs) in both series of the second experiment. In the first experiments, where the controls had a high frequency of SCEs, no increase in SCEs was recorded in either of the two series treated with x rays. The frequency of the isolabelling regions, in relation to the total labelling, was compared between control series and treated series. Analysis of the distribution of the isolabelled regions along the chromosome showed that the regions furthest from the centromere were most involved in this phenomenon and that, for the most part, the isolabelling was not directly associated with an exchange. The results have been interpreted to mean that SCEs and isolabelling regions are due to different phenomena, the former resulting from an exchange involving the whole chromatid, the latter from subchromatid exchanges probably involving a single polynucleotide strand. (auth)

22923 IONIZING RADIATION AND CHROMOSOMAL ABERRATIONS IN MALNUTRITION. Betancourt, M.; de la Roca, J. M.; Cravioto, J. (Cientifica Hospital del Nino, Mexico City). Lancet; No. 7892, 1332-1333(30 Nov 1974).

A high frequency of chromosomal aberrations was reported in children with severe protein-calorie malnutrition (Armendares, S., Salamanca, F., Frenk, S., Nature, 232: 271(1971)). The effects of various doses of radiation on lymphocyte cultures were studied, to test the hypothesis that this higher frequency of chromosomal aberrations could be due to an increased susceptibility of malnourished subjects to different agents. Irradiation of blood samples with x rays (dose range 0 to 200 rads) prior to culturing for 72 hours showed that lymphocytes from severely malnourished and healthy children showed both similar numbers of cells with chromosomal aberrations, and total numbers of aberrations, at every level of radiation. Treatment of blood cultures with tritiated thymidine (1 μCi per ml.) gave noticeably higher levels of chromosomal aberrations in both groups, but no significant difference in response between the blood cultures from malnourished and healthy children. Malnutrition is not therefore necessarily accompanied by an increase of chromosomal aberrations, and an increased sensitivity to ionizing radiations cannot be the explanation of this reported higher frequency of chromosomal aberrations. Other factors, for example specific deficiencies of methionine, vitamin B_{12} or folate, or alternatively the natural range of incidences of chromosomal aberrations found in healthy people being also applicable to malnourished individuals, may provide the explanation. (UK)

22924 BIOLOGICAL DAMAGE FROM INTRANUCLEAR CARBON-14 DECAYS: DNA SINGLE-STRAND BREAKS AND REPAIR IN MAMMALIAN CELLS. Cleaver, J. E.; Burki, H. J. (Univ. of California, San Francisco). Int. J. Radiat. Biol.; 26: No. 4, 399-403(Oct 1974).

The efficiency of ^{14}C decays originating from ^{14}C-methylthymidine (^{14}CTdR) in causing single-strand breaks in DNA in frozen mammalian cells was determined, together with the x-ray dose equivalent to a ^{14}C decay, and the extent of break rejoining on thawing. The experimental values for the dose equivalence of ^{14}C decay in the range 0.4 to 0.8 rads per ^{14}C decay for both frozen and unfrozen cells were about twice the theoretical values for the ^{14}C beta dose; this discrepancy was ascribed to the effects of cross irradiation, with only small contributions from local transmutational effects and differences in repair processes. The estimates of ^{14}C damage to DNA in frozen cells could be used for estimating possible radiation damage to cells in tissues in a normal unfrozen state after corrections for the effects of freezing had been applied. Each ^{14}C decay would be expected to produce about 8 to 14 single-strand breaks per cell in unfrozen cells. (UK)

22925 CONDITIONED MEDIUM FROM PLATEAU-PHASE CELLS: EFFECT ON GROWTH OF PROLIFERATIVE CELLS AND ON REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE. Horowitz, I. A.; Norwint, H.; Hall, E. J. (Columbia Univ., New York). Radiology; 114: No. 3, 723-726(Mar 1975).

In vitro cell cultures grown into plateau phase may be more suitable than exponentially growing cells as a model for tumor cell growth in vivo. Conditioned medium extracted from cells in plateau phase inhibits growth of log-phase cultures of either the same or a different cell line. Attempts to demonstrate that this inhibition is due to a heat-labile diffusible substance have failed. Conditioned medium extracted from plateau-phase cultures was effective in enhancing repair of potentially lethal damage following x irradiation. Cell survival is significantly increased following a six-hour postirradiation culture in conditioned medium as opposed to complete fresh medium. (auth)

22926 EXPRESSION FOR RADIOSENSITIVITY BASED ON THE M TARGETS-1 HIT MODEL INCLUDING RECOVERY OF TARGETS HIT. Abillon, E. (CEN de Saclay, Gif-sur-Yvette, France). Math. Biosci.; 23: No. 1/2, 11-23(Feb 1975).

The radiosensitivity as determined for the "m targets–1 hit" model, not including recovery, equals the function a of hitting the targets. The value of this parameter when recovery of the targets hit is included in this model is considered. A numerical study for values of $2 \leq m \leq 10$ shows that radiosensitivity λ_1 can then be approximated by the expression $\lambda_1 = aBe^{-Cm}$, where B and C are functions only of α/a, the ratio of probabilities of recovery and hit. (auth)

22927 ON THE NATURE OF THE OXYGEN EFFECT ON X-RAY-INDUCED DNA SINGLE-STRAND BREAKS IN MAMMALIAN CELLS. Roots, R.; Smith, K. C. (Stanford Univ., CA). Int. J. Radiat. Biol.; 26: No. 5, 467-480(Nov 1974).

The initial yield of DNA single-strand breaks in x-irradiated Chinese hamster ovary cells was about 4-fold higher in aerated samples than in those under extreme hypoxia (< 10 p.p.m. O_2), with DNA breakage yields of 3.6×10^{-9} and 0.85×10^{-9} dalton^{-1} krad^{-1} for air and N_2 irradiations, respectively. In cells in which metabolism had been inhibited by heating before irradiation, a maximal DNA break yield of about 8×10^{-9} dalton^{-1} krad^{-1} was found for samples irradiated in air or under moderate hypoxia (200 p.p.m. O_2), while extreme hypoxia (< 10 p.p.m. O_2) gave a yield of 4.3×10^{-9} breaks dalton^{-1} krad^{-1}. When cysteamine was added to heated cells irradiated under extreme hypoxia, the DNA break yield was close to that obtained for viable cells under extreme hypoxia. Similarly, when the reducing agent, $Na_2S_2O_4$, was added before irradiation to remove O_2 chemically, the breakage yield for heated cells was close to that obtained for viable cells under extreme hypoxia. A 10-fold difference in the radiation effect was observed between maximal sensitivity (8×10^{-9} dalton^{-1} krad^{-1}) seen in heated cells under air or 200 p.p.m. O_2 and the near to minimal sensitivity (0.85×10^{-9} dalton^{-1} krad^{-1}) seen in viable cells under < 10 p.p.m. O_2. A reasonable interpretation of these findings is that at radiation-induced free radical sites, fast chemical reactions occur which result in the fixation or the restoration of the damage. Thus, an oxygen-enhancement effect exists in mammalian cells for the x-ray-induction of DNA single-strand breaks; this effect appears to depend mainly upon radiation chemical events. (auth)

22928 INVESTIGATION OF MEMBRANE ALTERATIONS ON EXCITABLE MYOCARDIAL CELLS AFTER HIGH-ENERGETIC IRRADIATION. Timmermann, J. (Hamburg Univ. (F. R. Germany). Radiologische Klinik und Strahleninstitut). Strahlentherapie; 148: No. 2, 180-185(Aug 1974). (In German).

From 13th international congress on radiology; Madrid, Spain (15 Oct 1973).

Influx and efflux of potassium-42 under irradiation was measured on the membrane of isolated papillary muscles of guinea pigs, under constant excitation frequency. In the region of increased potassium shift on the membrane, single action potentials and the electromechanical linkage of the muscle cells were investigated. From the dose of 3,000 rd an increased potassium efflux was observed, from 4,000 rd a decreased potassium uptake. Under 6,000 rd measurable changes in the individual course of the action potential can be registered. The repolarization phase is extended, the electromechanical linkage is disturbed. This means a transitorily increased sensitivity of the single cells to dysrhythmias. (auth)

22929 CYTOLOGICAL MAPPING OF THE GENES ASSIGNED TO THE HUMAN A1 CHROMOSOME BY USE OF RADIATION-INDUCED CHROMOSOME BREAKAGE IN A HUMAN-CHINESE HAMSTER HYBRID CELL LINE. Burgerhout, W.; Bootsma, D. (Erasmus Univ., Rotterdam (Netherlands). Dept. of Cell Biology and Genetics); van Someren, H. (Medisch Biologisch Lab. TNO, Rijswijk (Netherlands); Rijksuniversiteit Leiden (Netherlands). Lab. for Molecular Genetics). Humangenetik; 20: No. 2, 159-162(1973).

2 figs.; 10 refs.

A human-Chinese hamster hybrid cell line was treated with x rays and subsequently cloned. In two clones, segregation between three markers assigned to the human A1 chromosome (6-phosphogluconate dehydrogenase, phosphoglucomutase 1 and peptidase C) was found. Chromosome analysis revealed an aberrated human A1 chromosome in both clones. The results suggest the following gene sequence on chromosome A1: 6 PGD, PGM_1 (on the short arm), Pep C (on the long arm). (auth)

22930 COMPARATIVE QUANTITATIVE ESTIMATE OF CHROMOSOME ABERRATIONS IN LYMPHOCYTES OF PERIPHERAL HUMAN BLOOD INDUCED BY DIFFERENT KINDS OF IONIZING RADIATION. Todorov, S. L. Khig. Zdraveopazvane; 17: No. 3, 251-258(1974). (In Russian).

A quantitative analysis was carried out of different chromosome disturbances produced in lymphocytes of peripheral human blood on irradiation in vitro with 180 kV x rays, gamma rays emitted by ^{60}Co, 50 MeV protons, and fission neutrons. The relative biological effectiveness in producing chromosome disturbances, on the assumption of a value for x rays equal to 1.0, was estimated at 0.86, 0.98, and 2.38 for gamma radiation, protons, and fission neutrons, respectively, on the basis of the results obtained. (JPRS)

22931 INVESTIGATIONS OF CHROMOSOMAL ABERRATIONS DETERMINED BY THE DOSE OF X RAYS AND THE DURATION OF CULTURES OF HUMAN LEUCOCYTES EXPOSED IN VITRO TO RADIATION. Slowikowska, M. G.; Grzymala, W. J. (Panstwowy Zaklad Higieny, Warsaw (Poland)). Rocz. Panstw. Zakl. Hig.; 24: 755-761(1973). (In Polish).

Investigations of the effects of radiation on the development of chromosomal aberrations in leucocytes from human blood were carried out in vitro. The duration of cultures was 56 or 72 hours. The blood from 5 adults was exposed to the following radiation doses of x rays: 0, 12, 24, 48, 96, 192, 384, and 768 R. The mean number of chromosomal breaks per metaphase increased with the dosage of radiation being nearly twice higher in 56-hour cultures. (auth)

22932 EFFECT OF HEAT AND RADIATION OF SYNCHRONOUS CHINESE HAMSTER CELLS: KILLING AND REPAIR. Gerweck, L. E. Fort Collins, CO; Colorado State Univ. (1974). 95p. University Microfilms Order No. 75-4591.

Thesis (Ph. D.).

Chinese hamster cells were as sensitive to thermal killing (45.5°C) under hypoxic conditions as under aerobic conditions. Synchronous aerobic cells exposed to heat and x-rays were most sensitive when heat preceded radiation. Heat treatment for 9-11 minutes during G_1 or 7 minutes during S substantially reduced or eliminated the shoulder and increased the absolute value of the slopes of radiation survival curves by a factor of 1.25-1.4. Cells were sensitized by heat to subsequent irradiation for up to 6 hours during G1 and for 12 hours during S. Nine minutes of heat treatment during G_1 delayed cell cycle progression into S for approximately 18 hours, and the repair of heat damage was not associated with cycle progression. However, S phase cells, heat treated for 7 minutes, did not begin repair until the cells had progressed to the $S-G_2$ boundary. Survival increased when heat was delivered at intervals after irradiation. The 20-30 minute repair half-time between treatments was the same as the half-time of repair between split-doses of radiation. Heat treatment prior to split-dose radiation treatment eliminated the capacity of cells to repair radiation sublethal damage for at least two hours. Recovery from heat damage as determined by a second dose of heat, occurred with a half-time of three hours, and was complete within six hours. The repair kinetics of heat damage as determined by subsequent irradiation were different than repair of heat damage determined by a second heat treatment. Therefore, heat damages two repairable targets. Since heat eliminates the capacity of cells to accumulate radiation sublethal damage, one of the heat targets appears to be a target of radiation. The similar thermal sensitivity of aerobic and hypoxic cells and elimination of cell age response to radiation with heat suggest that an effective cancer treatment protocol using heat and radiation could be established. (Diss. Abstr. Int., B)

Radiation Effects on Microorganisms

Refer also to abstract 22949.

22933 (AED-CONF-74-440-009) MANIFESTATION OF RADIATION-INDUCED MUTATIONS AT THE CAN-1 LOCUS IN SACCHAROMYCES CEREVISIAE. Gocke, E.; Manney, T. R. (Kansas State Univ., Manhattan (USA)). 1974. 6p. (In German). INIS

From annual meeting of the Deutsche Gesellschaft fuer Biophysik; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

In Saccharomyces cerevisiae, the resistance towards the L-arginine analogue L-canavanine is due to the inactivation of the CAN-1-gene product, a specific arginine permease. Experiments for the study of the manifestation of the mutation induced by radiation (uv, x-rays) were conducted by applying a system developed by W. L. Whelan, allowing very simple selection of both forward and back mutation. The manifestation of the mutation essentially depends on the concentration of free arginine (or its precursors) in the nuclei, and on the very rapid decomposition of the permease in the potential mutants. (GE)

22934 CHANGE IN SENSITIVITY OF CELLS AFTER SPLIT DOSE RECOVERY. A Further Test of the Repair Hypothesis. Bryant, P. E. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 26: No. 5, 499-504(Nov 1974).

Culture media suspensions of the alga Chlamydomonas reinhardii were exposed to split doses of irradiation with 5 MeV electrons in an investigation of the mechanisms of the observed decreased sensitivity of these cells to a second dose. The cell suspensions were shaken for 3 hours in the light after the first dose (14 krads); a series of graded single shot doses were then given at either 50 krads per minute or 500 krads per minute. The single-dose survival curve D_0 value (2.25 krads) was increased by a factor of 1.67 (to 3.75 krads) for the fractionated dose survival curve. There was no difference apparent in survival between cells given the second dose at 50 krads per minute and those given the second dose at 500 krads per minute. These results did not support the hypothesis that fast repair during the second irradiation is responsible for the increased resistance. Two alternative explanations are offered. (1) The increased resistance of cells after they have shed sub-lethal damage may result from an increased capacity to repair potentially lethal damage after irradiation and (2) the increased resistance may result from a change in the physical or structural nature of those sites which have shed sub-lethal damage. (UK)

22935 UNATTACHED RADON DECAY PRODUCTS IN MINE AIR. Mercer, T. T. (Univ. of Rochester, NY). Health Phys.; 28: No. 2, 158-161(Feb 1975).

Reference is made to the work of Raghavayya and Jones (Health Phys.; 26: 417 (1974)) in which activity concentrates of particulate and unattached radon decay products in mines were measured. Values of f (= unattached activity/total activity) for RaB reported generally exceeded those for RaA while the values for RaC were about the same as those for RaA. It is suggested that the method of analysis employed has some anomalous aspects and that more reasonable estimates of f are found if a simpler interpretation of the calibration data used is adopted. Using such an interpretation, new f values are obtained which present a picture of non-particulate decay product activity in mine air that differs significantly from that presented by the original values. (UK)

22936 LOSS OF POTASSIUM FROM E COLI AFTER X-IRRADIATION. Myers, D. K.; Johnson, L. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Int. J. Radiat. Biol.; 26: No. 4, 395-397(Oct 1974).

Potassium loss from Escherichia coli B/r and B_{s-1} was measured under different conditions to determine whether the depression of respiration following exposure to high doses of x radiation could be attributed to direct radiation damage to the cell membrane. There was no appreciable loss of potassium ions from growing E. coli cells that were irradiated and subsequently incubated (1 or 2 hours at 0°C or 37°C) in nutrient broth, using doses of x radiation of up to 75 krads; however, inhibition of growth and respiration was demonstrated, particularly at a dose of 75 krads and incubation at 37°C. Although some membrane damage was demonstrated, the results suggested that this particular type of membrane damage was not sufficient to explain the depression of respiration and growth observed in nutrient media at 37°C. The E. coli cells in buffered saline showed a considerable loss of potassium ion after irradiation and incubation at 0°C. The radiation doses (34 to 45 krads) required to cause 50 per cent loss of potassium ion under these conditions were very similar to those previously reported for mammalian erythrocytes and lymphocytes, suggesting that when other metabolic effects are minimized, the intrinsic radiation damage in these diverse cells is similar. (UK)

22937 YIELD OF SINGLE-STRAND BREAKS IN THE DNA OF BACTERIOPHAGE LAMBDA IRRADIATED EXTRA- AND INTRACELLULARLY WITH GAMMA-RAYS IN OXIC AND ANOXIC CONDITIONS. Srivastava, B. S. (Univ., Brussels). Int. J. Radiat. Biol.; 26: No. 4, 391-394(Oct 1974).

There is a controversy over the mechanism of the effect of oxygen on the production of breaks in cellular DNA by ionizing radiations. The presence of oxygen could modify the nature of breaks

(probably in terms of repair), or alternatively enhance the yield. The production of single-strand breaks in the DNA of extracellularly-irradiated phage λ, and in intracellularly-irradiated λ DNA, was therefore investigated; gamma irradiations were carried out under both oxic and anoxic conditions. Analysis of the molecular weights of the λ DNA in alkaline sucrose velocity gradients led to the conclusions that the initial number of gamma-ray-induced single-strand breaks in DNA was equal under oxic and anoxic conditions, the bacterial DNA polymerase I repaired very quickly a fraction of breaks from DNA, and in anoxic conditions a majority of the breaks, depending on the dose, required active DNA polymerase I for their repair. (UK)

22938 MULTIPLICITY REACTIVATION OF HUMAN CYTOMEGALOVIRUS INACTIVATED BY ULTRAVIOLET LIGHT. Albrecht, T.; St. Jeor, S. C.; Funk, F. D.; Rapp, F. (Pennsylvania State Univ., Hershey). Int. J. Radiat. Biol.; 26: No. 5, 445-454 (Nov 1974).

The sensitivity to inactivation by ultraviolet light (uv) of two strains (AD-169, C-87) of human cytomegalovirus (CMV) was determined and compared with the relative sensitivities of Herpes simplex virus (HSV) type 1 and type 2. The survival curves were multicomponent. The inactivation rates from the first component indicated that CMV (D_{37} dose ~200 ergs/mm^2) was more resistant to uv-inactivation than either HSV-1 or HSV-2 (D_{37} dose ~90 ergs/mm^2). Multiplicity reactivation (MR) could be clearly demonstrated for uv-irradiated CMV. MR occurred at multiplicities of infection (MOI) corresponding to 0.003 plaque-forming units (PFU) per cell of unirradiated virus. In contrast, MR for HSV was not pronounced at an MOI corresponding to 1.0 PFU per cell. These data suggested that defective particles of CMV, incapable of plaque formation before uv irradiation, participated in the genetic interactions which were responsible for the MR observed. (auth)

22939 DAILY VARIATIONS IN THE PRODUCTION OF AFLATOXINS BY ASPERGILLUS FLAVUS NRRL-3145 FOLLOWING EXPOSURE TO ^{60}Co IRRADIATION. Applegate, K. L.; Chipley, J. R. (Ohio State Univ., Columbus). J. Appl. Bacteriol.; 37: No. 3, 359-372 (Sep 1974).

Spores of the toxigenic fungus Aspergillus flavus NRRL-3145 were exposed to γ irradiation and allowed to germinate. The increase in the production of aflatoxins B_1 and B_2 following inoculation on cracked red wheat or in a liquid synthetic medium was greater than that which occurred in similarly treated cultures derived from non-irradiated spores. Variations in aflatoxin production were also observed daily for both the control and irradiated cultures developing on both media, with maximum toxin production varying from 2 to 10 days of incubation. The most notable increases in aflatoxin production occurred from cultures that developed from spores irradiated with 150, 200, and 300 krad. Exposure to 400 or 600 krad resulted in the complete inhibition of spore germination and, consequently, no aflatoxin was produced. The quantities of B_2 toxin produced were significantly lower than that of B_1 toxin, except in the synthetic medium where B_2 production was comparable with that of B_1. Cultures developing from non-irradiated spores exhibited a diphasic curve in production of aflatoxin G_1 when grown on wheat, with maximum toxin production occurring on the 4th and 10th day of incubation, while in the synthetic medium, G_1 production occurred as a monophasic curve. In the wheat, irradiation of A. flavus spores with 25, 100, 150, 200, or 300 krad caused significant increases of G_1 toxin over the amounts of the same toxin produced by non-irradiated controls. Similarly, exposure of spores to 200 krad and subsequent growth in a liquid synthetic medium resulted in significant increases in the amounts of G_1 toxin produced compared with non-irradiated controls. Except for the 200 krad irradiation, the amounts of G_2 toxin produced daily by spores were generally lower than those of G_1 toxin in either the wheat or the synthetic medium. Media, time of incubation, and selected irradiation levels affected the daily and total amounts of aflatoxins produced. (auth)

22940 INCREASED RESPONSE OF ANOXIC BACILLUS MEGATERIUM SPORES TO RADIATION AT HIGH DOSE-RATES. Purdie, J. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.); Ebert, M.; Tallentire, A. Int. J. Radiat. Biol.; 26: No. 5, 435-443 (Nov 1974).

Bacillus megaterium spores were irradiated in aqueous suspensions with 5 μs pulses of electrons. The sensitivity of anoxic spores (N_2) increased with increasing dose-rate in the range 10 to 10,000 rads/μs. The response of oxic spores (O_2) was unaffected by these changes in dose-rate. OH radical scavengers prevented part of the dose-rate effect. N_2O sensitized spores at low dose-rates but not at high dose-rates. Reduction in the pulse length over the range 5 to 0.5 μs caused a decrease in the response characteristic of high dose-rates. The average lifetime of the radicals effective in increasing the anoxic response was about 2 to 5 μs. (auth)

22941 IRRADIATION OF FOOD. Bugyaki, L. (Institut d'Hygiene et d'Epidemiologie, Brussels). J. Belge Radiol.; 57: No. 5, 387-407 (1974). (In French).

Criteria were studied for the harmlessness of irradiation as a food-preservation process. The glucose and proteins of bactotryptone, irradiated at 5 Mrads, do not increase the Escherichia coli C 600 (λ) lysogenous bacteriophages, compared to the induction produced by direct irradiation of the strain or to the exposition to nitrogenous yperite. The possible mutagenic effect is therefore different. Wheat flour freshly irradiated at 5 Mrads shows physico-chemical changes. When given to mice as 50% of their ration, it leads to a higher incidence of tumors and a greater number of meiotic chromosome alteration (besides some discreet physiopathological changes in fertility and longevity). Immunoelectrophoresis in agar or agarose gel does not allow any detection of irradiation of meat, fish, or eggs. A vertical electrophoresis in starch gel can lead to a differentiation between frozen or chilled meat and the one that is irradiated at 0.5 or 5 Mrads, but the same thing can't be said for fish or eggs. Lastly, an irradiated mushroom shows every sign of freshness but, when planted in a suitable medium its cuttings do not present any cell proliferation which could give a rapid and simple method of detecting the irradiation. (auth)

22942 CHROMOSOME ABERRATIONS IN SYRIAN HAMSTER EMBRYO CELLS TRANSFORMED AFTER EXPOSURE TO ULTRAVIOLET-IRRADIATED HERPES SIMPLEX VIRUS TYPE 1 OR 2. Nachtigal, M. (Univ. of Craiova, Romania); Duff, R.; Rapp, F. J. Nat. Cancer Inst.; 54: No. 1, 97-105 (Jan 1975).

Six Syrian hamster embryo cell lines (14-012-8-1, KOS-6-1, 333-8-9, 333-2-29, MS-4-1, FR-6-1), developed after exposure of primary cultures to different strains of uv-irradiated herpes simplex virus (HSV) type 1 or 2, were analyzed for chromosome aberrations. All the cell lines showed chromosome stability (number of chromosomes were maintained within a narrow range of variation in the diploid region) and a low incidence of polyploids, endoreduplications, and metaphases with pulveration or extensively fragmented chromosomes. The cell lines, passaged over long periods of time in vitro, developed marker chromosomes that suggested a clonal-type evolution of the cell populations. Two cell lines, 333-8-9 and 14-012-8-1, showed two different marker chromosomes with large heterochromatic regions. Chromosomes with abnormal heterochromatic regions, which often appeared like prominent secondary constrictions, were found in all the cell lines we examined. The level of chromosome breakage was low in all the cell lines except the highly tumorigenic cell line 333-2-29, which had a high incidence of cells with single or double chromatinic bodies. The abnormal heterochromatic regions that occurred on marker chromosomes and prominent secondary constrictions were interpreted as a possible chromosomal effect of the HSV. The karyotypic stability and low incidence of open breaks might have been the result of uv irradiation of the HSV. (auth)

22943 STUDY OF THE INFLUENCE OF GAMMA-IRRADIATION OF FRUITS AND JUICES ON THE PHYSIOLOGICAL ACTIVITY OF YEAST SACCHAROMYCES ELLIPSOIDEUS. Nakhmedov, F. G.; Frumkin, M. L.; Bushkanets, T. S.; Golubeva, Z. F. (Prikl. Biokhim. Mikrobiol.; 10: No. 1, 169-173 (Jan 1974). (In Russian).

For English translation see the journal Appl. Biochem. Microbiol.

Apples of the brand Papirovok and grapes of the brand Khemchug-Saba were irradiated with ^{60}Co gamma rays at doses of 0.3, 1.0 and 1.5×10^6 rads, and then aseptically homogenized. The homogenate was inoculated with the yeast Saccharomyces ellipsoideus. It was shown that the ground pulp and juices obtained from fruits and berries irradiated at doses of 0.3 to 1.0×10^6 rads have no effect on the rate of fermentation and respiration of the yeast cells. Products obtained at irradiation doses above 1.0×10^6 rads noticeably inhibited the physiological activity of the cells. (tr-INIS)

Radiation Effects on Plants

22944 (CERN-74-25) EFFECT OF ^{60}Co GAMMA RAYS, 600-MeV PROTONS, AND 14- AND 400-MeV NEUTRONS ON THE PRINCIPAL ROOT OF VICIA FABA. Laurent, J. M. (European Organization for Nuclear Research, Geneva (Switzerland)). 19 Dec 1974. 126p. (In French). Dep. NTIS (US Sales Only) $9.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble, France.

The effects of γ rays, neutrons, and protons of high energies on the growth rate of Vicia faba bean roots were measured. A model is described for predicting the growth rate of Vicia faba, from which can be calculated the survival fraction of cells at doses that

may be expected in radiation accidents. The models for cell survival are discussed, and it is shown that the relative biological effectiveness of 600 MeV proton beams, and 14 and 400 MeV neutron beams can be computed. (FR)

22945 RADIATION INDUCED MORPHOLOGICAL MUTANTS IN SESAMUM ORIENTALE L. Nayar, G. G. (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta); 33-34: No. 2-4, 41-53 (1971).

The agronomic characters of four x-ray induced morphological mutants in S. orientale L. viz. WFM, SSM isolated from var. T16 (black seeded) and SSM_2 and Chlo.mut. isolated from var. T10 (brown seeded) were studied. WFM, SSM, and SSM_2 showed early sprouting and increased growth while the Chlo.mut. showed delayed germination and growth. The mean leaf size, plant height and number of branches were greater in WFM and SSM as compared to T16. The mean time of flowering was early in SSM and SSM_2 while it was late in WFM and the Chlo.mut. as against their respective parents; the differences were significant. In mean yield of fruits per plant, WFM and SSM were superior to T16. A large scale trial has indicated that the seed yield in the mutants WFM, SSM, and SSM_2 was slightly higher than their parents. WFM, SSM, and SSM_2 showed an increase in oil content, the increase in SSM and SSM_2 being 6 to 10 per cent. The quality of oil as indicated by color and peroxide value (keeping quality) was also superior in WFM and SSM. The development of three flowers per node in SSM (otherwise solitary and axillary), two from modified nectary glands on either side of the leaf, provides some information on the phylogeny of the nectary glands and would appear to be of some economic significance. (auth)

22946 X-RAY INDUCED CHLOROPHYLL-DEFICIENT MUTANT IN JUTE. Chatterjee, A. (Jute Agricultural Research Inst., Barrackpore, India). Sci. Cult. (Calcutta); 40: No. 7, 325-326(Jul 1974).

Dry seeds of Corchorus olitorius were exposed to 50,000 R x radiation and planted. Plants in the second and third generations were observed for mutations. Some plants in the F2 generation had chlorophyll-deficient yellow-green leaves and were stunted in growth; these plants bred true in succeeding generations. The mode of segregation and Mendelian ratios of the characteristics studied are discussed. (HLW)

22947 GAMETIC STERILITY INDUCED BY GAMMA RAYS IN LUFFA ACUTANGULA ROXB. Katiyar, R. B.; Roy, S. K. (Banaras Hindu Univ., India). Curr. Sci. (India); 44: No. 5, 165-166(5 Mar 1975).

Dry seeds were exposed to 20 to 40 kR doses of gamma radiation; there was an inverse relationship between pollen viability and dose levels. Selfing and crossing experiments between treated and untreated plants were then conducted. Results showed that both gametes of the F_1 plants contributed to sterility. (HLW)

22948 EFFECT OF GAMMA IRRADIATION ON DIPLOID AND TETRAPLOID SEEDS OF CAJANUS CAJAN (L.) MILLSP. Shrivastava, M. P. (JNKVV, Jabalpur, India). Curr. Sci. (India); 44: No. 5, 167-168(5 Mar 1975).

Diploid and tetraploid seeds of pigeon peas were exposed to 0 to 60 krad of gamma radiation. The seeds were planted and observations were made on germination, survival, seedling height, and number of leaves. In diploids germination, survival, seedling height, and number of leaves were significantly reduced as the dose increased. In tetraploids the 15 krad dose increased germination, seedling height, and number of leaves; higher doses reduced these characteristics. (HLW)

22949 INNOCUOUSNESS OF POTATOES IRRADIATED BY FAST ELECTRON BEAM AND GAMMA-RAYS TO DEFER SPROUTING. Shillinger, Yu. I.; Kamaldinova, L. M. (Akademiya Meditsinskikh Nauk SSSR, Moscow. Inst. Pitaniya). Vop. Pitan.; No. 6, 50-55(Nov 1973). (In Russian).

The possible toxic properties of potatoes irradiated with gamma rays and fast electrons (30 krads), the effect on the reproduction function, and genetic effects were studied. The mutagenic properties of irradiated potatoes were investigated by the method of dominant lethal mutations. It was concluded that on irradiating potatoes with low doses of ionizing radiation it is evident that no stable substances possessing mutagenic properties are formed. (tr-INIS)

22950 STUDIES ON THE USE OF U-120 CYCLOTRON AND FAST NEUTRON GENERATOR IN NEUTRON IRRADIATION OF SEEDS FOR MUTATION. Hyczkowski, J. (Institute of Nuclear Physics, Krakow (Poland)). Hodowla Rosl., Aklim. Nasien.; 17: 145-159(1973). (In Polish).

Fast neutrons produced in the U-120 cyclotron and fast neutron generator were used for the irradiation of seeds aiming at the radiation induction of mutation. The neutrons of mean energy of some 5.5 MeV were obtained from nuclear reactions of $^{9}Be(d,n)^{10}B$ and $^{9}Be(\alpha,n)^{12}C$ in the cyclotron. The neutrons of energy 14.1 MeV were produced from the reaction of $^{3}(H/d,n)^{4}He$ in the fast neutron generator. Barley seed of Himalaya and Damazy varieties as well as wheat seed of Ciano 67 variety were irradiated. The radiation effect was measured by the method of reduction of seedling height in a growth chamber. The results proved the U-120 cyclotron fit for neutron irradiation of seed for the needs of plant breeding; the irradiation conditions were either similar or even better than that obtained in the nuclear reactors of the international program FAO/IAEA. The mentioned installations are capable of treating seed with neutron dose of 1000 r for 24 minutes at a distance of 20 cm from the target. The gamma contamination was by 130 r lower than that obtained from the reactors adapted specially to irradiation of seed. The mean energy of the neutrons produced in the cyclotron was found to be three times higher than that obtained from the nuclear reactor. The advantage of the cyclotron is a possibility of regulating the doses of irradiated objects, even the big ones, by changing the distance of them from the beryl target. (auth)

22951 THE RADIOECOLOGY OF POGONATUM URNIGERUM (L.) PAL. BEAUV. Sarosiek, J.; Kola, W.; Orda, A. (Wroclaw Univ. (Poland)). Acta Soc. Bot. Pol.; 42: 241-252(1973).

Within the area of the radiation anomaly near Kowary (Sudetes), the moss Pogonatum urnigerum grows on sites with natural gamma radiation of the soil within the limits of 0.05 to 0.91 mR/h. By way of detailed ecological analysis, five stenotopic habitats of P. urnigerum were singled out, differing, however, in radiation level. On these microhabitats the intrapopulation variability, radioactivity, and ecological properties of the P. urnigerum populations were investigated. It was demonstrated that radiation within the above mentioned range is an essential ecological factor conditioning the ecotype differences in Pogonatum urnigerum, and among them the developmental anomalies. (auth)

22952 MUTAGENEC EFFECT OF X-RAYING AND OF N-NITROSO-N-METHYLUREA (NMH) TREATMENT ON SERRADELLA (ORNITHOPUS SATIVUS BROT). Wojciechowska, W. (Polska Akademia Nauk, Poznan. Zaklad Genetyki Roslin). Genet. Pol.; 14: 269-294(1973).

X-irradiation of the R_1 of two seradella varieties, Mazurska and Bydgoska, produced in the R_2 and R_3 generations a certain number of mutants fit for selection; these were compared with the initial form and most of them subjected to a genetical analysis. The influence of NMH on the M_1 generation of the Bydgoska variety was also studied. (auth)

22953 INFLUENCE OF THE PHYSIOLOGICAL STATE OF DRY SEED ON THE BIOLOGICAL RESPONSE TO ^{137}Cs GAMMA RADIATION. Nuzhdin, N. I.; Samokhvalova, N. S. (AN SSSR, Pushchino-na-Oke. Inst. Biologicheskoj Fiziki). Izv. Akad. Nauk SSSR, Ser. Biol.; No. 2, 275-279(Mar 1974). (In Russian).

The mutagenic effect of gamma rays depends clearly on the physiologic state of dry seeds of A. sativa. The effect of the physiologic state of the seeds was manifest both at the moment of irradiation and also in the post-radiation period. The effect shows up in the general level of induced aberrant cells, in the appearance of various types of chromosomal rearrangements and in the course of the time-effect curves that reflect the frequency of aberrant cells during the six-day growth of the primary seedling. (tr-INIS)

Radiation Effects on Animals

Man

Refer also to abstracts 22057, 22058, 22634, 22639, 22861, 22919, 22923, 22930, 23067, 23503, 24426, and 24432.

22954 (AD-783772) AIRCREW VULNERABILITY IN NUCLEAR ENCOUNTERS. Albanese, R. A.; Pickering, J. E. (School of Aerospace Medicine, Brooks AFB, Tex. (USA)). Jul 1974. 23p. (SAM-TR-74-18; SAM-5-74). NTIS $3.00.

A computational method (algorithm) is described which estimates probable mission outcome resulting from crew exposure to prompt neutron gamma radiation and/or residual fallout radiation. The threat scenario presupposes that the crew has encountered one or more nuclear weapons; both aircraft and crew have survived the blast and thermal insults; and the aircraft is undegraded by the radiation (aircraft is survivable). Thus one is examining decreases in mission performance based upon crew irradiation only. (auth)

22955 (COO-3522-14, pp 39-46) DOSIMETRY OF ^{252}Cf MEDICAL NEUTRON SOURCES. Anderson, L.; Laughlin, J. S. 31 Oct 1974.

In biological and clinical dosimetry. Progress report, July 1, 1973-June 30, 1974.

Three patients were implanted with ^{252}Cf. A fourth patient had both an ^{192}Ir and a ^{252}Cf implant. All of these patients and metastatic lesions, previously untreated. Data relative to implantation, tumor dose, tumor size, and tumor or normal tissue response for the short period of follow-up are summarized. Tumor regression vs. time elapsed since implantation was plotted. The median regression (50%) varies from case to case. The ^{252}Cf dose distribution was computed using the BRACHY program. (ERB)

22956 (NRPB-R-25) RADIOACTIVE FLUORESCERS IN DENTAL PORCELAINS. O'Riordan, M. C.; Hunt, G. J. (National Radiological Protection Board, Harwell (UK)). May 1974. 19p. Dep. NTIS (US Sales Only) $4.00.

An examination of the use of uranium compounds in dental porcelains to simulate the fluorescence of natural teeth shows that the irradiation of the tissues of the mouth may well exceed the limit recommended by the International Commission on Radiological Protection for the average dose to the general organs or tissues of members of the public. The performance of the fluorescing agents is unsatisfactory in ultraviolet light, and they may be unnecessary in normal light. It is recommended that the practice be discontinued and that non-radioactive fluorescers be considered. (auth)

22957 (ORNL-TM-4830) REPORT OF LIAISON STUDIES WITH THE ATOMIC BOMB CASUALTY COMMISSION, HIROSHIMA, JAPAN, AUGUST 20, 1974-September 17, 1974. Kerr, G. D. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 34p. Dep. NTIS $4.75.

The liaison studies by the Atomic Bomb Casualty Commission (ABCC) and the Oak Ridge National Laboratory (ORNL) moved into a new phase, which will produce significant refinements in estimates of risk and radiation quality (RBE) of neutrons derived from epidemiological studies of atomic-bomb survivors. During the latest liaison study, important new data were presented to the ABCC. These data dealt with depth dose distribution, which can be used to make in vivo dose estimates for survivors. Estimates of absorbed dose to the breasts of women survivors and survivors exposed in utero were made for immediate use in their studies. These estimates are of great interest at present because of new dose-specific analyses of breast cancer being made at the ABCC and the Jablon-Stewart controversy over the risk of radiation exposure to a fetus. Examples are presented in this report to show that the new phase of liaison studies can refine current estimates of risk derived from the ABCC's epidemiological studies by factors of two or more. These examples are drawn from data presented in several recent and authoritative reports by committees of the National Academy of Sciences and the United Nations. Although the emphasis was on in vivo dosimetry, some time was devoted to older, but still important, phases of the liaison studies. These were finalization of tissue kerma-distance curves used in the T65D estimates of radiation exposure to survivors, unknown T65D exposure cases in the major samples of the ABCC, and radiation exposures of survivors who are now residing in the United States. A study of a group of 200 to 250 will be completed in early 1975 and a report summarizing data on this group will be completed by mid-1975. These 200 to 250 survivors represent about one-fourth of the estimated total residing in the United States. (auth)

22958 (PB-231856) ENVIRONMENTAL RADIATION DOSE COMMITMENT: AN APPLICATION TO THE NUCLEAR POWER INDUSTRY. Final Report. (Office of Radiation Programs, Rockville, Md. (USA). Div. of Criteria and Standards). Feb 1974. 90p. (EPA-520/4-73-002). NTIS $4.00.

The concept of environmental dose commitment was developed to encompass the radiation doses to populations implied by this irreversibility, extended to include the calculation of resultant potential adverse health effects, and applied to the specific case of the potential consequences of the next 50 years of normal operations of the United States nuclear power industry. Only the potential impact of the release of four types of long-lived radionuclides, namely tritium, krypton-85, iodine-129, and the actinides has been considered, and therefore the report does not purport to provide an evaluation of the overall impact of the industry. (GRA)

22959 (RD/B/N-2935) RE-ASSESSMENT OF EYE DOSIMETRY IN THE CEGB. Charles, M. W.; Hill, M. J.; Macfarlane, B. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 49p. Dep. NTIS (US Sales Only) $5.50.

The present status of personal eye dosimetry in the United Kingdom Central Electricity Generating Board (CEGB) is critically reviewed. Detailed data regarding the radiobiology and morphology of the eye, and typical depth dose curves and eye dose records of personnel at Magnox nuclear power stations are presented in appendices. Possible modified or new eye dosimeters are considered which could lead to the recording of the dose to the most radiosensitive region of the eye rather than to the surface of the eye, as at present. (auth)

22960 IRRADIATED LUNG CANCER. An Autopsy Analysis of Spread Pattern. Abadir, R.; Muggia, F. M. (Albert Einstein Coll. of Medicine, Bronx, NY). Radiology; 114: No. 2, 427-430 (Feb 1975).

The spread pattern was studied in 48 autopsied cases of irradiated, apparently localized lung cancer. Disease was found in the upper abdomen in 52%; in the brain in 8.7%; in the bones in 20.8%; and confined to the thoracic cavity in 27%. Radical irradiation controlled 38% locally. The pattern of metastasis in these irradiated lung tumors did not seem to differ from that of unirradiated lung cancers reported elsewhere. (auth)

22961 PERMISSIBLE LEVELS FOR OCCUPATIONAL EXPOSURE TO RADON DAUGHTERS. Harley, J. H. (Atomic Energy Commission Health and Safety Lab., New York); Harley, N. H. Health Phys.; 27: No. 6, 593-598(Dec 1974).

A permissible level for airborne radon daughter products in occupational exposure can be set in several ways. The three considered in this note are the working level (W.L.), the estimated dose to the lung, and the concentration of α emitters in air. The method of relating the α activity measured in the field on a filter paper to the W.L. is considered. It is shown that the W.L. only serves as a numerical convenience since the unattached fraction of RaA (^{218}Po) is not considered in the W.L. formula and other aerosol characteristics are also ignored. A number of lung dosimetry models developed to estimate the doses from radon and its daughters are discussed. The ratio of the estimated dose using one of these models to the measured α activity on a filter paper is tabulated. However none of the current dose models is universally accepted. The total RaA + RaC' concentration in the air per 1000 alpha dis/min on the filter paper for the prescribed measurement conditions are listed. It is concluded that present methods of evaluating radon daughter exposure are either impractical (dosimetry) or have deficiencies as an index to hazard (W.L. or α-emitter concentration). The use of a single measurement of α activity on a filter to derive the quantity selected for exposure control adds an additional error. Any standard set for a permissible level should recognize and describe these deficiencies. (UK)

22962 METHODS FOR REDUCING EXPOSURE TO PERSONNEL LEAK-TESTING SEALED RADIUM SOURCES. Thomas, J. (King's County Hospital Center, Brooklyn); Pasternack, B. S.; Bohning, D. E.; Vacirca, S. J. Health Phys.; 28: No. 2, 111-121 (Feb 1975).

In a previous report (Thomas et al. Health Phys.; 25: 259 (1973)), a group test procedure was proposed that would minimize exposure to personnel leak-testing sealed radium sources by reducing the required number of tests. The procedure was based on two assumptions: (a) there will be at most a single leaking source in any given test group, and (b) the resulting exposure is directly proportional to the number of leak tests performed. Whereas the validity of the first assumption finds it basis in leak test data available in the literature, the requirement of the second assumption may not be readily satisfied. In the present work, this requirement is lifted and consideration is given to the more realistic situation where the exposure is directly proportional to the activity of the group being tested. This leads to a group leak-testing procedure which in many instances results in a considerable reduction in exposure. Consideration is also given to storage arrangements and it is shown that, given an inventory of sealed radium, sources, minimum exposure during leak-testing results when the distribution of sources among drawers is as alike as possible with respect to the number, arrangement, and activity of the sources per drawer-assuming use of the leak-testing procedure recommended in this paper. (auth)

22963 DISTRIBUTION EFFECTIVENESS FACTORS FOR THE HUMAN BONE MARROW SYSTEM EXPOSED TO SPACE PROTONS. Billings, M. P.; Langley, R. W. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). Health Phys.; 27: No. 6, 581-588(Dec 1974).

Using the stem cell survival model and a detailed computerized man model, distribution effectiveness factors (DEF) were estimated for the bone marrow system for proton exposure conditions typical of manned space flight. The DEF is a dose-modifying factor, which attempts to provide a common basis for risk assess-

ment for some body organs under differing radiation depth-dose patterns. The regime of parameters for which the effect of non-uniform dose distribution in bone marrow may be significant is indicated. It is concluded that the DEF can be neglected for typical manned missions in low earth orbit, except possibly for the combination of relatively large doses (greater than 40 rads) and relatively soft proton spectra. (auth)

22964 RELATION BETWEEN JUVENILE CANCER AND OBSTETRIC RADIOGRAPHY. Holford, R. M. (Atomic Energy of Canada, Chalk River). Health Phys.; 28: No. 2, 153-156(Feb 1975).

The original analysis of the data from the Oxford Survey of Childhood Cancers by Stewart and Kneale (Lancet 1: 1185 (1970)) showed a marked, and apparently linear, relationship between the x-ray dose received by a pregnant woman and the probability of her child dying from cancer before reaching the age of ten years. The same data is here analyzed by a method advocated by Fisher (Phil. Trans. R. Soc. A.; 222: 309 (1922)). This analysis provides strong support for the linear hypothesis in this case, as distinct from either a hidden association or a threshold model, in agreement with the original claim of Stewart and Kneale. (UK)

22965 COMPARATIVE ANALYSIS BY VARIOUS MATHEMATICAL MODELS FOR BEST FITTING OF DICENTRIC YIELDS IN HUMAN LYMPHOCYTES EXPOSED TO DIFFERENT KINDS OF RADIATIONS. Todorov, S. A. (Centre of Infectious and Parasitic Diseases, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 10, 1451-1453(1974).

The effect of LET on the mathematical function best expressing the relationship between number of dicentrics produced and the radiation dose was investigated. It was found that when lymphocytes of human peripheral blood were exposed to acute radiation with a low LET, the relationship between quantity of dicentrics and dose is best fitted by the second degree polynomial, and in the case of radiation with a high LET by a linear model. (ERB)

22966 NSD FORMULA. Orr, J. S. (Western Regional Hospital Board, Glasgow); Berry, R. J.; Wiernik, G.; Patterson, T. J. S.; Hopewell, J. W. Brit. J. Radiol.; 47: No. 563, 824(Nov 1974).

The first letter challenges the analysis and conclusions of Dr. Berry and colleagues in the field of time/dose relationships (Berry, R. J., Wiernik, G., Patterson, T. J. S., and Hopewell, J. W., 1974, British Journal of Radiology; 47: 277-281). The reply from these authors in the second letter refuses the criticisms; Dr. Orr's arguments were based either on the overlap between individual measurements in the small numbers of animals used, or on very small differences in skin fields for different fractionation schedules. It is emphasized that the most significant general conclusion from the results is that radiation doses delivered by different fractionation schedules, which the NSD scheme predicts should produce comparable biological results, did not in fact do so. (UK)

22967 TOTAL BIOLOGICAL DOSE. Morrison, R. A. (Univ. of Kansas, Kansas City). Radiology; 114: No. 3, 717-721(Mar 1975).

The nominal standard dose concept is used to define the total biological dose or cumulative radiation effect at a point for treatment regimens employing two or more radiation modalities. Various clinical applications are illustrated. A convenient nomographic method for determining the total biological dose is presented. (auth)

22968 EFFECTS OF DIAGNOSTIC X-RAY EXPOSURE ON THE HUMAN FETUS: AN EXAMINATION OF THE EVIDENCE. Oppenheim, B. E.; Griem, M. L.; Meier, P. (Univ. of Chicago). Radiology; 114: No. 3, 529-534(Mar 1975).

Epidemiological studies have demonstrated an increased incidence of morbidity and mortality among children exposed prenatally or preconceptually to diagnostic x rays, as compared to nonirradiated controls. In those studies radiation exposure occurred on a selective basis, as the examination was always medically indicated. Comparisons of those studies and comparable ones in which radiation exposure occurred on a nonselective basis (from routine pelvimetry examinations or atomic bomb radiation) indicate that the latter studies do not confirm the former and a significant discrepancy is present in each instance. Thus, some doubt is cast on the validity of the former studies. (auth)

22969 ABSORBED GAMMA DOSE RATE FOR IMMERSION IN A SEMI-INFINITE RADIOACTIVE CLOUD. Dillman, L. T. (Ohio Wesleyan Univ., Delaware). Health Phys.; 27: No. 6, 571-580(Dec 1974).

A method is presented by which it is possible to obtain estimates of dose rate in the body as a function of depth for a person at the air-ground interface of a semi-infinite half space of air which is uniformly contaminated with a radioactive photon emitter. The method involves calculating the photon flux density as a function of energy in an infinite air medium and using the computed spectrum as a source incident upon the reference man phantom. Interactions of the photons in the body are followed by Monte Carlo techniques and resulting dose rates determined at 12 initial photon energies ranging from 0.01 to 4.0 MeV. Dose rates at other initial photon energies may be obtained by interpolation. Perturbations of the surface dose rate from one-half the equilibrium value far inside the cloud due to the change in density and composition at the air-ground interface are shown to be small. Perturbations in the dose rate due to the presence of the phantom are considered in detail. (auth)

22970 STUDIES FOR THE DETERMINATION OF FIELD DISTANCES IN COBALT-60 TELETHERAPY FOR UNIFORM DEPTH DOSE DISTRIBUTIONS IN PHANTOMS. Ayebiara-Arhu, T. 1972. 36p. (In German). INIS.

Available from the library of the Univ. Heidelberg.

Experimental investigations are discussed in order to determine the optimum distance between two fields in ^{60}Co-teletherapy that will allow a uniform dose distribution at various depths of the focal region. Measurements were performed by means of film dosimetry on an appropriate phantom. (GE)

22971 STRAHLENSCHUTZFIBEL. (Radiation Protection Guide). Klost, W. (Siemens A. G., Berlin (F. R. Germany)); Schmoelling, J. (Senat fuer Arbeit und Soziales, Berlin (F. R. Germany). Referat Strahlenschutz und Immissionschutz). SIS-Schriftenreihe. Berlin, F. R. Germany; Kluge (1974). 71p. (In German).

The radiation protection guide explains as far as is necessary the fundamentals of atomic physics and shows, by means of examples written and illustrated, where work is being done with radioactive materials and how one can protect oneself against this radiation. (GE)

22972 TECHNICAL RADIATION PROTECTION MEASURES AT THE SURGICAL IMAGE INTENSIFIER. Ewen, K. (Zentralstelle fuer Sicherheitstechnik, Strahlenschutz und Kerntechnik der Gewerbeaufsicht des Landes Nordrhein-Westfalen, Duesseldorf (F. R. Germany)); Schmitt, G. (Essen Univ. (Gesamthochschule) (F. R. Germany). Radiologisches Zentrum). Roentgenpraxis; 27: No. 9, 216-221(Sep 1974). (In German).

The technical measures to be taken in order to meet the requirements laid down in the rules for radiation protection controls according to paragraph 4 par. 1 of the X-Ray Decree and in DIN-Norm 6811 for the safe operation of a surgical image intensifier are explained. (GE)

22973 HAEMATOLOGISCHE FUNKTIONSDIAGNOSTIK IN DER RADIOLOGIE. (Hematological Function Diagnostics in Radiology). Chone, B. Strahlentherapie. Muenchen, F. R. Germany; Urban und Schwarzenberg (1974). 206p. (In German). (ISBN-3541062711).

Answers are given to numerous hematological problems that crop up in the routine use of radiation or that are to be considered in combined radiation and chemical therapy. Not merely diagnostic indications are given but also effective therapeutic guidelines. In addition, the basic problems of the radiation protection control are discussed and directives to the rationalization of the hematological findings are given. (GE)

22974 LATE SPINAL IRRADIATION NECROSIS WITH TRANSVERSE SYNDROME: A FALSE OPINION. Oeser, H.; Zuelch, K. J. (Freie Univ. Berlin (F. R. Germany). Klinikum Steglitz; Max-Planck-Institut fuer Hirnforschung, Koeln (F. R. Germany). Abt. fuer Allgemeine Neurologie). Strahlentherapie; 148: No. 3, 303-312(Sep 1974). (In German).

The case history of, and post-mortem findings in, a patient in whom a malignant tumor had grown extradurally to surround the spinal marrow cuff-fashion thus causing transverse syndrome are presented. Subsequent irradiation (x rays, focal dose 4,800 R/38 d) appeared indicated following incomplete surgery. Transverse syndrome developed in the same segment one and a half years later. The arguments put forth in a civil case in favor of irradiation damage are repeated and discussed. Autopsy after almost 14 years revealed fibrotic constriction of the spinal marrow. The supposed irradiation damage to the spinal marrow could not be confirmed histologically. Conclusions are drawn in respect to the medical practice. (auth)

22975 APPROACH TO SUMMARIZING INTERRELATIONS BETWEEN FUNCTIONS USED IN RADIOTHERAPY DOSE CALCULATIONS. Shrivastava, P. N. (Allegheny General Hospital, Pittsburgh). Med. Phys.; 1: No. 4, 223-225(1974).

An approach to summarizing interrelations between functions used in radiotherapy dose calculations is suggested. A mnemonic diagram is proposed, which should be useful for radiation physicists in radiotherapy to obtain at a quick glance the definitions and interrelations between the commonly used functions like back-scatter factor, percent depth dose, tissue-air ratio, scatter-air ratio, and scatter function. The conditions under which the measurements must be made for these functions and interrelations to be valid are described. Rules for application of the diagram and some practical examples are included. The diagram also serves as a very effective teaching aid. (auth)

22976 PERTURBATION OF NEUTRON DOSE DISTRIBUTIONS BY LUNG TISSUE. McGinley, P. H.; McLaren, J. R. (Emory Univ. Clinic, Atlanta). Med. Phys.; 1: No. 4, 219-222(1974).

The influence of lung tissue on depth dose distributions, produced by beams of fast neutrons, was determined. Muscle-equivalent ionization chambers were utilized in conjunction with thermoluminescent dosimeters to establish the neutron and gamma ray-dose deposited in a phantom of the thoracic region of the body containing lung components. All irradiations were carried out at a target-skin distance of 125 cm with neutron beams of 10×10-cm field size at the surface of the phantom. From these measurements, the authors conclude that the presence of lung tissue results in higher dose levels for points at depths greater than the midpoint of the lungs as a result of the increased transmission of neutrons by low-density lung tissue. An examination of the dose measurements revealed that the portion of the total dose due to gamma rays is of the order of 4 to 10% for points in lung and muscle-equivalent fluid. (auth)

22977 BREMSSTRAHLUNG RADIATORS AND BEAM FILTERS FOR 25-MeV CANCER THERAPY. Sherman, N. K. (National Research Council of Canada, Ottawa); Lokan, K. H.; Hutcheon, R. M.; Funk, L. W.; Brown, W. R.; Brown, P. Med. Phys.; 1: No. 4, 185-192(1974).

Bremsstrahlung spectra and on-axis depth-dose distributions due to 25.5-MeV electrons incident on seven different Ta and one Al radiator were studied, with and without beam-hardening filters of Al and Pb. The photon spectra were measured with a gamma-ray spectrometer consisting of a liquid deuterium target viewed by a time-of-flight detector of photoneutrons. A remote-controlled, miniature ion chamber was used to measure depth-dose profiles in a water phantom. The Ta radiators ranged in thickness from 0.012 radiation length up to 1.0 X_0. The thinner the radiator, the harder was the measured spectrum. The maximum forward yield was obtained for a thickness of about 0.3 X_0. The forward yield and spectral shape of the photon beam from 0.07 X_0 of Al as radiator were very similar to those from 0.06 X_0 of Ta. Beams produced in Ta radiators and filtered by 27.28 g/cm^2 of Al gave a harder spectrum than those filtered by 15.06 g/cm^2 of Pb. Total absorption cross sections of Al and Pb for photon energies between 4 and 24 MeV were obtained which agree with theoretical calculations, within measurement errors. The depth in water at which the dose fell to 0.5 of peak dose was greater when the Al filter was used than when the Pb filter was used. For end point energies greater than 10 MeV, beam-hardening and field-flattening filters should be made, if space permits, of low-atomic-number materials. (auth)

22978 UNEXPECTED RADIUM-226 BUILD-UP IN PYRITE-BURNING SULPHURIC ACID PLANTS. Basson, J. K.; Selzer, A. (Atomic Energy Board, Pelindaba, Pretoria). Health Phys.; 28: No. 2, 123-126(Feb 1975).

During a radiation survey of a municipal refuse dump, radioactive residues were discovered, whose origin was traced back to waste from a sulphuric acid plant and identified as radium. The iron pyrite used for the production of sulphuric acid, is obtained from gold/uranium mines mainly by a flotation process and was found to contain radioactive daughter products of uranium which occurs in South African gold ores. Radium is then leached from the iron oxide in the gas cleaning processes and deposited as radium sulphate scale inside pipework and other parts of the gas purification and cooling sections of the plant. Radiation surveys and results of samples analyzed, indicated that employees at the plants are exposed to both external and internal radiation hazards and that precautionary measures are essential. However, the protective measures normally taken against the chemical hazards proved to be effective in this respect. (auth)

22979 HYPERURICEMIA IN CANCER OF THE LARYNX. Preliminary Report. Zanca, P. (Univ. of Texas, San Antonio). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 55-59(Jan 1975).

Serum uric acid values were obtained in 94 patients with cancer, prior to and upon completion of radiation therapy. Hyperuricemia was persistent in all of the patients with carcinoma of the larynx. Explanation for this finding is uncertain. Serum uric acid levels for all other cancers, in this series, were not impressive. (auth)

22980 AGGRESSIVE SURGERY IN TREATMENT FOR PAROTID CANCER: THE ROLE OF ADJUNCTIVE POSTOPERATIVE RADIOTHERAPY. Guillamondegui, O. M.; Byers, R. M.; Luna, M. A.; Chiminazzo, H. Jr.; Jesse, R. H.; Fletcher, G. H. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 49-54(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

A 7 year follow-up of 120 patients with malignant parotid cancers reveals parotidectomy to be an adequate procedure for low-grade, nonaggressive lesions. The addition of radiation therapy postoperatively will improve local and regional control of high-grade, agressive lesions. Postoperative radiation therapy may also make the removal of the facial nerve unnecessary in certain clinical presentations. (auth)

22981 CONTROL BY IRRADIATION ALONE OF NONFIXED CLINICALLY POSITIVE LYMPH NODES FROM SQUAMOUS CELL CARCINOMA OF THE ORAL CAVITY, OROPHARYNX, SUPRAGLOTTIC LARYNX, AND HYPOPHARYNX. Schneider, J. J. (Mt. Sinai Medical Center, Miami Beach, FL); Fletcher, G. H.; Barkley, H. T. Jr. Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 42-48(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

The records from 1948 through 1967 of 344 previously untreated patients with squamous cell carcinoma of the oral cavity, oropharynx, supraglottic larynx and hypopharynx who clinically positive cervical lymph node metastases staged N_1, N_{2A}, or N_{2B}, and whose initial neck treatment consisted of external radiation therapy alone were reviewed. After appropriate exclusions the study group consists of 183 patients. The dose to the lymph node(s) was calculated retrospectively. The control rates for N_1 lymph nodes are 91.5 per cent (76/83) and for N_2 lymph nodes 78.5 per cent (55/70) in the patients whose lymph node(s) were well included in the irradiated volume and received a known dose. A dose response analysis shows that doses in the range of 6,500 rads to a single lymph node, 3 cm. or less in diameter, produce 90 per cent control. When a nonfixed metastatic lymph node of 3 cm. or more in diameter or multiple lymph nodes are present or there is questionable coverage, external irradiation alone cannot be relied upon for control and a neck dissection should follow. (auth)

22982 PREOPERATIVE IRRADIATION IN RENAL CANCER: EVALUATION OF RADIATION TREATMENT PLANS. Rubin, P. (Univ. of Rochester, NY); Keller, B.; Cox, C.; Eassa, E. H. Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 114-122(Jan 1975).

Analysis of radiation treatment plans of a preoperative irradiation study of the kidney indicates that primary cancer has been treated to levels of 4,500 rads ±10 per cent in 90 per cent of the instances. The major problem, from the point of view of the radiation therapist's treatment planning, is the delivery of adequate doses to the regional nodal volume. Only 25 per cent received the prescribed dose. Special booster fields are required. Surgical resection of regional lymph nodes and renal vein thrombus, if present, is recommended, since the deliverance of full radiation doses is not likely without exceeding tolerance of vital normal tissues. (auth)

22983 INDICATIONS FOR ADJUNCTIVE CONSERVATIVE EXTRAFASCIAL HYSTERECTOMY IN SELECTED CASES OF CARCINOMA OF THE UTERINE CERVIX. Nelson, A. J. III; Fletcher, G. H.; Wharton, J. T. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 91-99(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawii (21 Apr 1974).

The survival rates for a selected group of patients with large central lesions, either squamous cell carcinoma or adenocarcinoma and managed by combining irradiation and a conservative extrafascial hysterectomy, are comparable to those of carcinoma of the cervix in general. Death is caused much more often by distant metastases and intercurrent disease than by failure within the irradiated volume. (auth)

22984 CARCINOMA OF THE CERVIX: A TIME DOSE ANALYSIS OF CONTROL AND COMPLICATIONS. Chism, S. E.; Keys, H. M.; Gillin, M. T. (Walter Reed General Hospital, Washington, DC). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 84-90(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

The use of 3 dose assessment systems is compared. The Manchester approach which measures a dose to Point A and Point B; the Paris approach using rads and mgh; and Ellis's NSD approach appear to have equal value in predicting probability of pelvic control and the likelihood of complication over the dose range employed at this hospital. Control increases with higher dose schemes, but complications appear to be influenced by other variables not accounted for in the 3 systems. (auth)

22985 IRRADIATION OF STAGE I AND II HODGKIN'S DISEASE. Fazekas, J. T.; Cox, J. D.; Turner, W. M. (Walter Reed General Hospital, Washington, DC). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 154-162(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

One must conclude on the basis of the above analysis that tumor doses in excess of 3,600 or 4,000 rads add only to morbidity, and not to local control. Secondly, the technique of irradiating involved lymph node groups only, leaving other areas to be treated later, apparently denies the possibility of cure to a significant number of patients with early stage Hodgkin's disease. Recurrence or extension almost uniformly leads to eventual death from disease despite retreatment. No case of second primary cancer has been documented in the patient population included in this report. However, the number at risk is relatively small and chemotherapy was reserved only for generalized recurrence. Since the reported 20 times expected incidence occurred with the combination of total-nodal and multiple-agent chemotherapy, one would not expect an increased incidence of second primary lesions in this series. (auth)

22986 SURGERY AND POSTOPERATIVE RADIOTHERAPY IN THE TREATMENT OF SOFT TISSUE SARCOMAS IN ADULTS. Lindberg, R. D.; Martin, R. G.; Romsdahl, M. M. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 123-129(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

A retrospective review of 100 selected patients with soft tissue sarcomas treated by conservative excision and postoperative radiation therapy shows the following: In extremity lesions, a functional limb can be preserved. The 5 year survival rate free of disease is 62 per cent (23/37). The control rate of the soft tissue sarcomas is related to the anatomic site of origin rather than histologic type of the tumor except rhabdomyosarcomas. In lesions of the extremities, the control rate is 82 per cent (51/62). The first manifestation of spread is usually distant metastasis rather than regional lymph node metastasis. The complications can be minimized if sufficient attention is given to the placement of the surgical scar and the radiotherapeutic technique. (auth)

22987 THERAPEUTIC USE OF FRACTIONATED SUBTOTAL BODY IRRADIATION. Loeffler, R. K.; Puterbaugh, M. R. (North East Ohio Conjoint Radiation Oncology Center, Massillon). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 170-178(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

A technique is presented for the treatment of generalized radiosensitive malignancies. The results of fractionated STBI (subtotal body irradiation) in a group of 41 patients are at least as satisfactory as those achieved by any other therapeutic modality. Eight of 9 patients with generalized Stage III and IV nodular lymphocytic lymphoma, both well and poorly differentiated, are living without evidence of disease, from 15 to 82 months since treatment. (auth)

22988 LATE RECURRENCE IN MEDULLOBLASTOMA. King, G. A.; Sagerman, R. H. (State Univ. of New York, Syracuse). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 7-12(Jan 1975).

From 56th annual meeting of the American Radium Society; Maui, Hawaii (21 Apr 1974).

The authors present 3 cases of recurrence of medulloblastoma at 6 years, 6 years 7 months, and 7 years 4 months disease-free intervals from the time of diagnosis. Two of these cases have violated Collins' rule of survivorship; i.e., an interval longer than the patient's age plus 9 months being equivalent to cure. Two of the cases were biopsy proven recurrences of medulloblastoma and in the third, the recurrence was diagnosed on the basis of clinical and roentgenographic data. Other than for these late recurrences, our series is similar to other series reported in the literature. (auth)

22989 BASAL GANGLIA CALCIFICATION AS A LATE RADIATION EFFECT. Numaguchi, Y.; Hoffman, J. C.; Sones, P. J. Jr. (Emory Univ., Atlanta). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 27-30(Jan 1975).

Basal ganglia calcification following radiation therapy has rarely been documented in the literature. A case of diffuse bilateral basal ganglia calcification developing 6 years after irradiation of a hypothalamic glioma is presented. Review of previous reports and other causes of basal ganglia calcification are discussed. (auth)

22990 INFLUENCE OF OXYPHENYLBUTAZONE ON RADIATION INDUCED LUNG DISEASES. Mueller-Fassbender, H.; Klein, U.; Bublath, H.; Heinze, H. G. (Muenchen Univ. (F. R. Germany). Klinik und Poliklinik fuer Radiologie). Med. Klin. (Munich); 68: 478-483(1973). (In German).

6 figs.; 29 refs.

The effect of oxyphenylbutazone to inhibit radiation pneumonitis and fibrosis was tested in a double placebo experiment. 116 female patients with postoperative irradiation of carcinoma of the breast were included in these studies. Frequency and degree of severity of radiation pneumonitis could be reduced significantly. It was possible to realize the advantages of the prophylactic oxyphenylbutazone treatment during the stage of lung fibrosis that develops half a year later. No side effects of oxyphenylbutazone could be observed. In addition to x-ray diagnostics, lung scanning is a useful procedure. (auth)

22991 THE INFLUENCE OF RADIOPHOSPHORUS THERAPY ON THE DEVELOPMENT OF A MYELOFIBROSIS IN POLYCYTHEMIA VERA. Gruenholz, D. (Freiburg Univ. (F. R. Germany). Pathologisches Inst.). 9 Mar 1973. 42p. (In German). INIS.

4 figs.; 9 tabs.; 36 refs. Available from the library of the Freiburg Univ.

For investigations described, 58 myelotomies of the iliac crest were available from a group of 44 patients with polycythemia vera. These myelotomies were studied with a view to finding out whether the radiophosphorus therapy directly induces or only contributes to the occurrence of marrow fibrosis observed in the course of polycythemia vera, or whether this is a special phenomenon of the disease itself. Further, an attempt was made to establish a correlation between the histological findings concerning the marrow and the results of all other investigations regarding duration of sickness up to performance of myelotomy, mean age and sex, peripheral blood picture and size of liver and spleen, and this as a function of the therapeutic treatment. No increase in fibrosis could be found with enhanced therapeutic radiophosphorus dose, in four cases, even a reduction of fibrosis was observed. During the first few years following the onset of the disease, radiophosphorus therapy did not lead to an enhancement of fibrosis, only patients left untreated showed an increase in fibrosis. There seemed to be no dependence on age or sex of the further development of bone marrow fibrosis, neither with nor without therapy. The assessment of fiber density in the bone marrow does not allow conclusions to be made with regard to the manifestation of polycythemia vera in the peripheral blood picture. Due to the formation of secondary hemocytogenetic centres, the size of liver and spleen will be extended with increasing marrow fibrosis. There seems to be a dependence on the duration of the disease, with increase in spleen size being some years in advance to that of the liver. Based on these results the assumption is discussed that myelofibrosis represents a late stage of polycythemia vera and that patients left untreated will not live long enough to experience this stage. (GE)

22992 THE EFFECTS OF RADIATION ON THE COAGULANT AND FIBRINOLYTIC SYSTEMS. Bruhn, H. D.; Werner, H. (Kiel Univ. (F. R. Germany). Radiologische Klinik). Strahlentherapie; 148: No. 4, 347-349(Oct 1974). (In German).

1 fig.; 12 refs.

Coagulant and fibrinolytic systems were tested in 30 patients undergoing radiation therapy for tumours. The platelet count showed a statistically significant drop during such therapy. Analysis of the fibrinolytic systems revealed a reduction in the euglobulin time that was not statistically significant. Further in-vitro analysis of the effects of radiation on the fibrinolytic system showed that radiation doses of 3,000 down to 400 R will reduce the action of fibrinolysis activators. The biological significance of this phenomenon is discussed and the preventive use of SH-group donors investigated. (auth)

22993 VERIFICATION OF A PRACTICAL METHOD FOR MAKING INDIVIDUAL CORRECTIONS FOR INHOMOGENEITIES IN THE THORAX. Wright, A.E. (Department of Radiology, Baylor College of Medicine, Houston, Texas 77025); Strockbine, M.F. Med. Phys. 1: No. 6, 323-325 (Nov 1974).

Cobalt-60 teletherapy dose calculations utilizing a standard correction factor for thorax inhomogeneities can result in dose error due to patient

variability. Individual intracavitary measurements avoid this error but are impractical for routine clinical use. A graph has been constructed relating the ratio of measurements made with and without the patient in the beam to an equivalent water depth. With an ordinary ion chamber secured to the beamstopper, the dose was integrated during a 1-min rotation. A known water depth was used to derive apparent linear attenuation coefficients which, with the equation $D_0/D_t = e^{\mu t}$, enabled construction of the graph. To verify the method, tubes with dosimeters were positioned at the axis of rotation during the first treatment of patients with esophageal tumors. Agreement of corrected dose with measured dose is within 3% for 360 deg rotational treatment; uncorrected dose calculations would have resulted in errors of 5%-21%. (auth)

22994 COMPARISON OF FAST NEUTRON BEAMS FOR RADIOTHERAPY PRODUCED BY 17.3-MeV DEUTERONS INCIDENT ON BERYLLIUM AND DEUTERIUM TARGETS. Edwards, F.M.; Fielding, H.W.; Kraushaar, J.J. (Nuclear Physics Laboratory, Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302); Weaver, K.A. Med. Phys. 1: No. 6, 317-322 (Nov 1974).

Fast neutron beams produced by 17.3-MeV deuterons incident on a totally stopping beryllium target, a totally stopping deuterium gas target, and a 5.8-MeV-thick deuterium-gas target are compared. It is shown that the deuterium-gas target yields a significantly higher average energy and dose rate and may offer other advantages as well. (auth)

22995 CALCULATION OF THE EFFECTS CAUSED BY BONE PRESENT IN PHANTOMS IRRADIATED BY NEGATIVELY CHARGED PIONS. Santoro, R.T.; Alsmiller, R.G. Jr.; Chandler, K.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Med. Phys. 1: No. 6, 303-310 (Nov 1974).

The effects caused by bone present in phantoms irradiated by negatively charged pions on absorbed dose, cell survival, oxygen enhancement ratio, and relative biological effectiveness have been estimated using Monte Carlo methods. The influence of bone along the pion path and also the influence of a bone-tissue interface parallel to the direction of motion of the pions have been considered. Calculated results, as a function of spatial coordinates in a 30-g/cm^2-thick tissue phantom with bone both included and excluded, are presented. All of the biological data reported here are for T-1 human kidney cells. The extent to which the effects of bone in the path of the pion beam can be approximated by using results for tissue and measuring depth in the phantom in g/cm^2 is considered and discussed. (auth)

22996 ROLE OF THE PHYSICIST IN HEALTH AND HOSPITAL SERVICES. Caldirola, P. (Univ., Milan); Montesanti, M.I. G. Fis. Sanit. Prot. Radiaz.; 18: No. 3, 89-116(1974). (In Italian).

The establishment of a health physics service in Italian hospitals by law has resulted in the direction of systemic and rational attention to the question of ionising radiations and the handling of radioactive substances used for medical purposes. The tasks required by the relevant legislation will necessitate the training of a sufficiently large number of physicists skilled in protection and the employment of radioactive substances. The questions involved are discussed and the structure and activity of the type of health physics envisaged are indicated in the light of the many problems connected with public health and the needs of a modern hospital department. (auth)

22997 EFFICIENT TOOL FOR TUMOR THERAPY. Lo, S. K'o Hsueh Shih Yen; No. 6, 26-27(Jun 1974). (In Chinese).

The first induction [Van de Graaf] accelerator being used in China for radiation therapy at the Jih-t'an Hospital in Peking is described. It is particularly suited for treating tumors in unusual locations (e.g. the area near the heart) with minimal damage to normal tissue. It also reduces the incidence of complications and constitutional reactions, and was found to be more effective than deep x ray and cobalt-60. The article explains and illustrates the working principle behind the accelerator's operation in detail, and compares the effectiveness of the accelerator's depth-dosage rate with that for radium, conventional deep x ray, and cobalt-60. (JPRS)

22998 TRAINING IN MEDICAL RADIOLOGY. Zuppinger, A. Bern; International Society of Radiology (I. S. R.) ([nd]). 63p.

Various aspects of training in medical radiology are discussed in five chapters. The present status of radiology is discussed with regard to supply of radiologists; legal and actual situations in radiodiagnosis, radiotherapy, and nuclear medicine; and medical radiology by nonphysicians. Radiological training of medical students is discussed with regard to training in radiophysics and radiobiology, clinical teaching in radiology, and the examination in radiology. The status and training of radiologists is discussed with regard to the kind of training, training in diagnostic radiology, special training in radiotherapy and nuclear medicine, and general radiology. The last two chapters discuss continuing education of radiologists and training of medical radiological technicians. (HLW)

22999 PRINCIPLES OF DIAGNOSIS AND CLASSIFICATION IN RADIATION SICKNESS. Alekseev, G. I.; Kruglov, A. N. Voenno-Med. Zh.; No. 9, 23-26(1974). (In Russian).

The overall clinical picture of individuals with radiation sickness depends on the radiation dose to which they were exposed; at the present time analysis of the peripheral blood provides the most information on the severity of the condition. Blood studies should be conducted in 48 to 72 hr during which time only lymphocyte counts are of importance; 7, 8, and 9 days after exposure leukocyte counts are given primary attention, and thrombocytes in counts conducted 18 to 20 days after exposure. Clinically, first degree (light) acute radiation sickness develops on exposure to about 150 to 250 R, the second degree (moderate) acute radiation sickness develops on exposure to 250 to 400 R, the third degree of the sickness (severe) on exposure to 400 to 700 R, and the fourth degree (extremely serious) results from exposure to doses exceeding 700 R (over 600 rad to the bone marrow). In general, the length of hospital stay is 1 to 1.5 months in the light case, 2 to 2.5 months in the moderate case, and 2.5 to 3 months in the severe case. (JPRS)

23000 CRYOSURGICAL TREATMENT OF POSTRADIOTHERAPY RECURRENCES OF SKIN CARCINOMA. Przywara, S.; Adamus, J. (Instytut Onkologii, Gliwice (Poland)). Wiad. Lek.; 26: 1173-1176(1973). (In Polish).

Three cases of skin carcinomas with recurrences after radiotherapy treated by cryosurgery are reported. In 2 cases recurrences of basal-cell carcinoma and in 1 case a recurrence of planoepithelial carcinoma were present. Cure was effected in all cases. The method is believed to give better cosmetic results in selected cases than routine surgical methods. (auth)

23001 EXPOSURE TO RADIATION IN DENTAL RADIOLOGY. Mlosek, K. (Akademia Medyczna, Warsaw (Poland)). Czas. Stomatol.; 26: 411-415(1973). (In Polish).

Radiological investigations are the greatest additional source of exposure of the population to ionizing radiation causing not only harmful somatic consequences but genetic risk. It is concluded that radiological investigations should be used, therefore, only according to strict medical indications. (auth)

23002 SALIVARY GLAND NEOPLASMS FOLLOWING ATOMIC RADIATION: ADDITIONAL CASES AND REANALYSIS OF COMBINED DATA IN A FIXED POPULATION, 1957-1970. Belsky, J. L. (Atomic Bomb Casualty Commission, Hiroshima); Takeichi, N.; Yamamoto, T.; Cihak, R. W.; Hirose, F.; Ezaki, H.; Inoue, S.; Blot, W. J. Cancer; 35: No. 2, 555-559(Feb 1975).

A reappraisal was made of the relationship between exposure to atomic radiation in 1945 and the occurrence of salivary gland tumors in heavily exposed survivors. This was made possible by the discovery of 8 additional patients; the total now reported consists of 30 cases. In those exposed to 300+ rads, the number of cases was significantly ($p < .01$) greater than expected. This was found for the combined group and for malignant types, but not for histologically benign tumors. Our prior conclusion regarding the high-dose radiation effect upon salivary gland neoplasia remains unchanged in the reanalysis; however, our suggestion that younger persons were at significantly greater risk is weakened. (auth)

23003 INTRACEREBRAL CALCIFICATIONS APPEARING DURING THE COURSE OF ACUTE LYMPHOCYTIC LEUKEMIA TREATED WITH METHOTREXATE AND X RAYS. Flament-Durand, J.; Ketelbant-Balasse, P.; Maurus, R.; Regnier, R.; Spehl, M. (Univ. Libre, Brussels). Cancer; 35: No. 2, 319-325 (Feb 1975).

The case of a child aged 7 years who suffered from relapsing acute lymphocytic leukemia is presented. Treatment consisting mainly of oral and intrathecal methotrexate and x-ray therapy produced remission of the hematologic symptoms. Three years after the onset of the leukemia, mental deterioration gradually appeared. Radiography of the skull revealed diffuse bilaterial calcium deposits in both cerebral and cerebellar hemispheres. Four years after the onset of the disease, a hematologic relapse occurred. Behavioral disorders became more severe and the child died after a period of seizures and unconsciousness. The main pathologic data obtained by the study of a brain biopsy and after a complete postmortem examination consisted of calcifications located bilaterally in the cerebral and cerebellar cortex. No signs of leukemia were present. Cerebral calcification is an extremely rare complication in the course of the therapy of lymphocytic leukemia. Its possible causes are discussed. (auth)

Vertebrates

Refer also to abstract 22637.

23004 (AD-786882) EFFECTS OF VARIOUS DOSE RATES OF MIXED NEUTRON-GAMMA RADIATIONS ON THE LD50(60) RESPONSE OF SHEEP. Final Report, Feb 1968–Jun 1970. Mobley, T. S.; Persing, R. L.; Terry, J. L. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Sep 1974. 26p. (AFWL-TR-71-5). NTIS $3.75.

The report summarizes biological responses in sheep unilaterally exposed at three different dose rates of reactor-produced neutron-gamma radiations. The radiations employed in the studies were from a fission weapon simulator, the Sandia Pulsed Reactor (SPR), yielding a 5 : 1 neutron-to-gamma ratio. (GRA)

23005 (COO-1754-13) EFFECTS OF WHOLE-BODY γ-IRRADIATION ON THE BIOSYNTHESIS OF CERTAIN SERUM PROTEINS. Progress Report, January 1, 1974 to December 31, 1975. Neuhaus, O. W. (South Dakota Univ., Vermillion (USA). Dept. of Biochemistry). Oct 1974. Contract AT(11-1)-1754. 14p. Dep. NTIS $4.00.

Results are reported from studies on rats that demonstrate that whole-body irradiation stimulates only the Na^+-dependent A system for the transport of amino acids into the liver. Distribution ratios for the in vitro AIB uptake in Na^+-free media were the same for liver slices from normal and irradiated rats. This shows that irradiation did not influence the non-saturable or passive diffusion of AIB. Whole-body irradiation had no effect on the in vivo accumulation of the bicyclic model amino acid BCH which is transported exclusively by the Na^+-independent L system. Studies have been performed using AIB as a competitive inhibitor for the in vitro transport of L-methionine and cycloleucine. These studies also showed that irradiation stimulates only the A system of amino acid transport. Studies of AIB transport in a variety of tissues indicate that stimulation is not relatable to radiation sensitivity but rather to their metabolic activities. The stimulated amino acid transport reflects an elevated serum amino acid level possibly following the breakdown of muscle tissue. Our data indicate that the elevated amino acid transport promotes an increased gluconeogenic activity culminating in glycogenesis. (auth)

23006 (LA-5866-MS) SOME OBSERVATIONS ON THE COMPARATIVE EFFECTS OF INBREEDING AND WHOLE-BODY X-RAY EXPOSURE TO SEVENTY GENERATIONS OF MICE. Spalding, J. F.; Brooks, M. R.; Johnson, O. S. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

Male mice in each of 70 generations were sibling-mated after being exposed (whole-body) to 200 rad of x irradiation at 26 ± 2 days of age. A control line was sibling-mated for the same number of generations but received no x-ray exposure. Reproductive characteristics of importance to the continuance of the species were studied to determine the genetic impact of 70 generations of inbreeding alone and in combination with 200 rad of x irradiation to the male mice in each generation. The irradiated line had fewer conceptions (with correspondingly longer intervals between conceptions) and less mice born per breeding pair than the control line; however, irradiated line mice were significantly less cannibalistic and contributed 32% more progeny to the next generation than did an equal number of breeding pairs of their control counterparts. The major effect of inbreeding per se was in the born-to-weaned ratio. Control line mice with 70 generations of sibling matings weaned only 38% of the mice born, while control line mice, 65 generations earlier, weaned 86% of the mice born. Radiation, in combination with inbreeding for 70 generations, did not appear to produce genetic injury detrimental to survival of the species. (auth)

23007 (N-74-14813) REGULATORY BIOLOGY: DEPRESSED METABOLIC STATES. Meeting of October 18–20, 1971, National Aeronautics and Space Administration, Wallops Station, Wallops Island, Virginia. Holton, E. M. (ed.). (National Aeronautics and Space Administration, Wallops Island, Va. (USA). Wallops Station). Aug 1973. 175p. (CONF-711087-; NASA-TM-X-69354). NTIS $11.25.

A separate abstract was prepared for one of the papers included. (CH)

For an abstract of an individual paper see: 23008.

23008 (N-74-14813, pp 91-118) RADIOPROTECTION IN DEPRESSED METABOLIC STATES: THE PHYSIOLOGY OF HELIUM-COLD HYPOTHERMIA. Musacchia, X. J. (Univ. of Missouri, Columbia). Aug 1973.

From meeting of regulatory biology: depressed metabolic states; Wallops Island, Virginia, USA (18 Oct 1971).

In regulatory biology: depressed metabolic states.

Results are summarized from studies on the effects of depressed metabolism induced by hibernation and hypothermia on the γ radiosensitivity of ground squirrels. A method for the induction of hypothermia in rodents (rats, mice, hamsters, ground squirrels) in the laboratory by maintenance in a helium-cold environment is described. (CH)

23009 (N-74-26617) FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM UNDER THE COMBINED EFFECT OF STRESS FACTORS: IONIZING RADIATION, ACCELERATIONS, AND VIBRATION. Livshits, N. N. (ed.). Apr 1974. Translation of Funktsii Tsentralnoy Nervnoy Sistemy pri Kombinirovannom Deystvii Stress-Faktorov: Ioniziruy-ushchey Radiatsii, Uskoreniy i Vibratsii. (NASA-TT-F-15363). 202p. NTIS $13.25.

This collection presents experimental studies of the combined effect of dynamic factors (acceleration and vibration) and ionizing radiation on the functional state of the vestibular analysor, higher nervous activity, and animal behavior. The article summarizing the results of these and previously published works substantiates the theory of the importance of intracentral processes in the reactions of the central nervous system to applied combined forces. The collection also includes studies of the importance of changes in oxidizing metabolism in brain tissues in modifying action on radiation. (STAR)

23010 (ORNL-tr-2889) TREATMENT OF RADIATION-INDUCED NEOPLASMS OF THE OVARIES BY COMBINED ADMINISTRATION OF ANTAGONISTIC SEX HORMONES. Gubareva, A. V.; Galkovskaya, K. F. Translated by Martha Gerrard from Vop. Onkol.; 17: No. 7, 48-52(1971). 4p. Dep. NTIS $4.00.

Of a number of substances tested for the therapy of radiation-induced ovarian neoplasms of mice the only effective one was sinestrol [3-7, 10-12] administered in large amounts. However, continuous administration of large doses of estrogen to animals was accompanied by a number of undesirable effects: in many cases, activation of pyo-necrotic processes in the uro-genital organs, increase in frequency of development of cancer of the mammary glands, lymphoid leucosis, and adenoma of the pituitary. Among the complications that arise, the first two are so frequent and serious that they explain the rapid death of the animals. According to the data, irradiated mice given 0.25 mg of sinestrol per week live an average of 217.5 ± 8.3 days, while the average life of mice not given estrogen is 501.8 ± 24.0. A 4-fold decrease in the dose accompanied only by a temporary drop in the hyperplastic changes which inevitably developed in the sterilized ovary, and which in turn did not prevent neoplasms of the gonads, but increased the latent period of their development. (auth)

23011 (PB-235246) STUDY OF THE EFFECTS OF ADDITIONAL ENDOGENOUS HEAT. Annual Progress Report, 13 June 1972–13 June 1973. Huffman, F. N.; Norman, J. C. (Thermo Electron Corp., Waltham, Mass. (USA)). Jun 1973. Contract PH-43-66-982. 244p. (TE-4064-31-74; PH-43-66-982-7). NTIS $7.50.

The feasibility of implantable circulatory support systems depends on the ability of the body to dissipate the reject heat from the power source driving the blood pump. If the energy source is a radioisotope, the body must also tolerate chronic intracorporeal radiation. The objective of the endogenous heat program is to characterize the effects of intracorporeal nuclear radiation and additional thermal load on mammals. This program is a continuation of initial canine studies using electrical heat exchangers and subsequent efforts utilizing heat exchangers energized by 16- and 24-watt ^{238}Pu (Plutonium-238) capsules. More recently, the effects of RES (Radiation Equivalent Source)-24 capsules which simulate the neutron and gamma radiation environment from a 24-watt ^{238}Pu heat source have been evaluated in mongrel dogs. The long-term survivals in good condition of both ^{238}Pu and RES implanted dogs and primates, as well as the STS implantations, are encouraging that the anticipated reject heat and dose rate levels from implantable circulatory support systems may be permissible. (GRA)

23012 RENAL AND ADRENAL FACTORS IN RADIATION-INDUCED HYPERTENSION AND NEPHROSCLEROSIS. Lurie, A. G. Rochester, NY; Univ. of Rochester (1974). 269p. University Microfilms Order No. 75-1310.

Thesis (Ph. D.).

Experiments were conducted in order to investigate the effects of adrenalectomy on the incidence, severity, and rate of progression of radiation-induced hypertension and nephrosclerosis in male rats. Adrenalectomized and non-adrenalectomized rats

received either a single exposure of 500 R or 2000 R x radiation bilaterally to temporarily exteriorized kidneys, or a single exposure of 500 R to the whole body with shielding of temporarily exteriorized kidneys. Animals were sacrificed for study at 5 or 10 weeks following surgery and/or irradiation. The parameters which were evaluated are as follows: systolic blood pressure; gross pathology; renal histopathology; food and fluid intake; urine output; urine and plasma potassium, sodium, and chloride concentrations; plasma corticosterone concentration; total body weight; and other organ weights (kidneys, spleen, heart, hypophysis, and adrenals). Additional studies were performed on selected rats to determine: the plasma renin and angiotensin activity; and the effects of adrenalectomy performed 3 months after bilateral renal irradiation on systolic blood pressure and renal histopathology. (Diss. Abstr. Int., B)

23013 ROLE OF ANEMIA AS A TRIGGER OF MYELOID LEUKEMIA IN IRRADIATED RATS. Jarvis, J. H.; Whittaker, J. A. (Welsh National School of Medicine, Cardiff). Exp. Hematol.; 2: 212-218(1974).

The possible role of iron deficiency anemia in leukemia induction was studied in both irradiated and non-irradiated Wistar rats. Chronic iron deficiency anemia was produced by administration of an iron-deficient diet and the progress of the animals was followed for 40 weeks. The chronic anemia failed to trigger myeloid leukemia in rats rendered leukemia-prone by irradiation. This is in contrast to previous studies where an acute anemia has been shown to increase the incidence of leukemia in irradiated rats. Possible reasons for this discrepancy are discussed in the light of present knowledge of the role of hemopoietic stem cells in leukemia and the inter-relationship of these cells with mature cells. (auth)

23014 BLOOD PLATELET PRODUCTION AND RED CELL LEAKAGE TO LYMPH DURING THROMBOCYTOPENIA. Aursnes, I. (Univ. of Oslo). Scand. J. Haematol.; 13: 184-195(1974).

Previous investigations have shown that a vascular wall defect will usually, but not always, develop during irradiation-induced thrombocytopenia. This phenomenon has been further examined by observing the content of red cells in ear lymph in rabbits 9 to 10 days after exposure to a sublethal dose (660 rads) of whole-body irradiation during which the ears were shielded. Increased number of red cells in the ear lymph was found in about $^2/_3$ of 51 such thrombocytopenic animals (<35,000 platelets/μl blood). When a small dose of platelet antiserum was given to some of the remaining and similarly thrombocytopenic animals, a marked increase in the red cell content of the ear lymph also appeared in these cases. Results achieved in additional experiments with 660 rads exposure indicated that some production of blood platelets remained even during the days with most marked thrombocytopenia. Another group of animals was therefore exposed to the (lethal) dose of 1,300 rads which eliminated platelet production completely. These animals invariably developed an abnormal degree of vascular leakage of red cells to lymph already by days 4 to 5 after irradiation, when the levels of blood platelets were still 100,000 to 400,000/μl blood. When the same high irradiation dose was given to animals with their hindlegs shielded, neither marked thrombocytopenia nor signs of abnormal vascular leakage developed. It appears, therefore, that newly produced platelets or some factor connected with platelet production must be available in order to prevent the abnormal microvascular leakage of red cells from developing. (DE)

23015 EFFECTS OF IRRADIATION ON IN VITRO PHOSPHOLIPID EXCHANGE BETWEEN RAT PLASMA AND RED CORPUSCLES. Dousset, N.; Douste-Blazy, L. (INSERM, Toulouse). Int. J. Radiat. Biol.; 26: No. 5, 505-510(Nov 1974). (In French).

Phosphorus-32 labelled plasma (from rat blood sampled 22 hours after intraperitoneal injection of an isotonic solution of 500 μCi of $Na_2H^{32}PO_4$) was incubated at 37°C for 5, 10, or 30 minutes with gamma irradiated red blood corpuscles (10,000 rads; dose rate 1000 rad/min) in an investigation of the effects of radiation on the transfer of phospholipids between plasma and red blood corpuscles. The incorporation of (1-^{14}C)-palmitic acid into irradiated red blood corpuscles was also studied. Lipids in plasma and red corpuscles were analyzed by thin layer chromatography, followed by autoradiography of the chromatograms. Electron microscopy of the irradiated red blood corpuscles showed a somewhat finer and less granular cell structure, but no hemoglobin could be detected in the plasma by spectrophotometry at 564 nm. Irradiation of the red blood cells increased the exchange of all phospholipids, and particularly lysolecithins, but the extent of incorporation of (1-^{14}C)-palmitic acid from the plasma was unaltered by prior irradiation of the red cells. (UK)

23016 EFFECTS OF γ IRRADIATION ON BIOSYNTHESIS OF DIFFERENT TYPES OF RIBONUCLEIC ACIDS IN NORMAL AND REGENERATING RAT LIVER. Markov, G. C.; Dessev, G. N.; Russev, G. C.; Tsanev, R. G. (Bylgarska Akademiya na Naukite, Sofia). Biochem. J.; 146: No. 1, 41-51(Jan 1975).

The effect of γ irradiation (4000 rad) on the synthesis of ribosomal (pre-rRNA) and heterogeneous nuclear RNA (pre-mRNA) in normal and in regenerating rat liver was studied by using 40 min labelling with [6-^{14}C]-orotic acid. Partial hepatectomy caused a sharp transient increase in the specific radioactivity of the endogenous low-molecular-weight RNA precursors in the livers of both normal and irradiated rats. Irradiation of intact animals did not affect the pool. Irradiation enhanced the synthesis of pre-rRNA for at least 12 h. The synthesis of pre-mRNA was also enhanced, but only in the first 3 h after irradiation. Partial hepatectomy strongly stimulated the synthesis of both pre-rRNA and pre-mRNA. The synthesis of pre-rRNA was enhanced also in regenerating liver of animals irradiated before or after the operation. The conclusion could be drawn that the early increase in the synthesis of ribosomal RNA is a non-specific cellular response to different injuring factors. The only case where irradiation caused an early inhibition of RNA synthesis was that of pre-mRNA in regenerating liver. This supports the hypothesis that ionizing radiation does not suppress the transcription per se but affects the mechanisms of activation of new genes (cellular programming). (auth)

23017 RADIOPROTECTION OF AROUSING GROUND SQUIRRELS (CITELLUS TRIDECEMLINEATUS) BY ENDOGENOUS CATECHOLAMINES. Prewitt, R. L.; Musacchia, X. J. (Univ. of Missouri, Columbia). Experientia; 31: No. 2, 230-232(15 Feb 1975).

Naturally occurring radioprotection in hibernating ground squirrels has been reported. It was thought that radioprotection could also occur during arousal from hibernation since severe vasoconstriction occurs at that time, thus indicating the release of large amounts of norepinephrine. The possibility that vasoconstriction of such severity could cause radioprotection due to tissue hypoxia in blood forming organs seems likely. If this is the case, it should be blockable by the administration of the α-blocker phentolamine. Based on the experimental data using γ-irradiated and phentolamine-treated ground squirrels, it was concluded that the radioprotection (increased survival at 1200 R) seen in arousing ground squirrels appears to be due to a combination of release of endogenous catecholamines and a shift of the hemoglobin-oxygen dissociation curve to the left. Both mechanisms lead to radioprotection through the oxygen effect. (ERB)

23018 COMPARISON OF THREE AND FIVE TIMES WEEKLY FRACTIONATION ON THE RESPONSE OF NORMAL AND MALIGNANT TISSUES OF THE C_3H MOUSE. Probert, J. C.; Brown, J. M. (Stanford Univ., CA). Brit. J. Radiol.; 47: No. 563, 775-780(Nov 1974).

A comparison was made of the response of the KHT sarcoma, transplanted into the thighs of syngeneic C_3H mice and the response of the normal tissues of the irradiated leg to two fractionation régimes; six fractions in two weeks and ten fractions in two weeks. The response of the tumor, which was measured by the delay in growth to a fixed size, was found to be consistent with a fractional difference between the two régimes of approximately 11 per cent for dose fractions of between 200 and 600 rads. For the normal tissues, early skin reactions and deformity 48 weeks after irradiation were measured, and the mean fractional difference between the two régimes was 12 per cent for the early and 13 per cent for the late reaction. The values of the fraction number exponent in the nominal standard dose equation of Ellis were calculated for both the tumor and normal tissues and found to be consistent with the value of 0.24. (auth)

23019 NUMERICAL INCREASE OF GOMORI-POSITIVE GLIA IN RAT OPTIC NERVE FOLLOWING X IRRADIATION. Srebro, Z.; Dubis, K. (Akademia Medyczna, Krakow). Exp. Eye Res.; 19: No. 5, 485-491(Nov 1974).

The number of chrome haematoxylin (Gomori)-positive glial cells present in optic nerve of rats significantly increased following x-ray irradiation of the head region. This response was clearly dose-dependent. Sex differences were observed as regards the mode of the reaction of the Gomori-positive glia to the irradiation. (auth)

23020 POTENTIATING EFFECT OF PRIOR LOCAL IRRADIATION OF THE LUNGS ON THE DEVELOPMENT OF PULMONARY METASTASES. Peters, L. J. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol.; 47: No. 563, 827-829(Nov 1974).

The possibility of an increased risk of metastases after wide field radiotherapy was surveyed. The effect of unilateral lung irradiation on the metastatic behaviour of a spontaneous, well-differentiated chondrosarcoma in CBA/Ht mice was investigated experimentally. The results showed a significant increase in metastases in the irradiated lungs compared with the contra-

lateral controls, and a greater absolute mass of metastatic tumour in mice receiving 2,000 rad than in those receiving 1,600 rad of x radiation. Consideration is given to the various theories for the mechanisms of this effect. The contrasting observed clinical benefits of prophylactic irradiation in the treatment of some neoplasms are assessed in relation to the different mechanisms. The actual mechanism needs to be elucidated experimentally before the potential radiotherapeutic hazard can be minimised. (UK)

23021 CHROMOSOME ABERRATIONS IN RABBIT PERIPHERAL BLOOD LYMPHOCYTES EXPOSED IN VIVO OR IN VITRO TO 300 R OF X RAYS. Benova, D. K.; Vuglenov, A. K.; Baev, I. A. (Research Inst. of Radiobiology and Radiation Hygiene, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 10, 1459-1461 (1974).

The frequencies of chromosomal aberrations in rabbit peripheral lymphocytes exposed in vitro or in vivo to x rays at a dose of 300 R were compared. The results gave no indication of a difference in chromosome aberration yields between in vitro and in vivo exposures. The significance of these findings for biological dosimetry is discussed. (ERB)

23022 SIMULTANEOUS ATP-AET-SEROTONIN PROTECTION OF SPERMATOGONIA FROM TRANSLOCATIONS INDUCED BY FRACTIONATED X RAYS IN THE MOUSE. Baev, I. A.; Benova, D. K. (Hygiene Centre, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 10, 1463-1464(1974).

The protective effectiveness of the simultaneous administration of ATP, AET, and serotonin on mouse spermatogonia following two whole-body x-ray exposures of 300R each was investigated. A reduction in translocation yield was the criterion used to indicate protection. The results indicated that, under the given fractionation conditions, simultaneous administration of ATP, AET, and serotonin at reduced doses does afford protection. The authors conclude that in important protective role is played by ATP especially in cases of fractionated or prolonged irradiation. (ERB)

23023 RETICULOENDOTHELIAL SYSTEM BLOCKADE AS AN EFFECTIVE METHOD OF RADIOPROTECTION. Mori, K. J.; Seto, A.; Ito, Y. (Kyoto Univ.). Experientia; 31: No. 1, 112-113 (1975).

Polystyrene latex particles and glycogen were injected into mice 24 h prior to whole-body x irradiation. Twelve and 14 out of 15 mice treated with latex particles survived doses of 650 and 700 R respectively. Observations of endogenous spleen colony formation showed that survival of hemopoietic stem cells was remarkably increased by pretreatment with latex particles. Glycogen did not affect survival of mice. It was concluded that blockade of RES with latex particles protected the animals against radio-induced death and created a favorable environment for hemopoietic stem cells to recover from radiation. (HLW)

23024 EFFECTS OF X IRRADIATION ON THE MECHANICAL PROPERTIES OF SKIN. Ranu, H. S.; Burlin, T. E.; Hutton, W. C. (Polytechnic of Central London). Phys. Med. Biol.; 20: No. 1, 95-105(Jan 1975).

The elastic properties of rat skin previously irradiated with single doses from 1000 to 3000 rad were studied. The measurements were made 50 and 120 d after irradiation on skin specimens immersed in saline at 37°C. The tests were carried out on a tensile testing machine. The load extension curve, which was plotted to the point of rupture, exhibited two portions identified with the alignment of the collagen fibres and then their subsequent stretching. The elastic properties associated with fibre alignment were little affected by these doses of radiation but the stiffness of the collagen itself tended to decrease with increasing dose, exhibiting a shoulder in the dose response curve. (auth)

23025 ALPHA ABSORPTION MEASUREMENTS APPLIED TO LUNG DOSE FROM PLUTONIUM-239. Harley, N. H.; Pasternack, B. S.; Harley, J. H. (New York Univ.). Health Phys.; 28: No. 1, 61-67(Jan 1975).

Experimental curves of ^{239}Pu alpha attenuation and stopping power were obtained in polycarbonate plastic, which is essentially identical to human tissue. With these curves the alpha dose rate was calculated for the human tracheobronchial tree for $^{239}PuO_2$ deposited on bronchial airways. Dose rate curves were derived for two types of PuO_2 exposure. One computation was for PuO_2 deposited as 0.06 μm particles, the other for a 2 μm PuO_2 particle fixed on the bronchial wall. Generalized dose rate curves are presented so that the dose at any depth in bronchial epithelium may be computed if the activity deposited on the bronchial airway is known. The dose rates for ICRP maximum permissible air concentration for continuous exposure are computed as a specific example. The dose rate computed for the 0.06 μm particles is 0.014 rads/yr to the basal cells in the entire bronchial epithelium while that for the fixed 2 μm particle can be a maximum of 2.3 rads/min to a few tens of cells. (auth)

23026 TUMOR AND NORMAL TISSUE RESPONSE TO IRRADIATION IN VIVO: VARIATION WITH DECREASING DOSE RATES. Fu, K. K.; Phillips, T. L.; Kane, L. J.; Smith, V. (Univ. of California, San Francisco). Radiology; 114: No. 3, 709-716(Mar 1975).

From 59th scientific assembly of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Continuous x irradiation in vivo at dose rates ranging from 0.54 to 274 rads per minute was performed in mice using the EMT6 tumor, the gut clone system, and the bone-marrow CFU system. A progressive increase in D_0 and decrease in $\bar{n}$ were seen with decreasing dose rates in the EMT6 tumor and the gut clone system. The D_0 showed little change in the bone-marrow CFU system. These findings are related to the $D_2 - D_1$ values obtained from split-dose experiments at conventional dose rates. The results do not fit the various mathematical models proposed for correlating the effects of continuous low-dose rate irradiation and acute exposure. (auth)

23027 DOUBLE-TRACER METHOD FOR DETERMINING THE PROTEOLYTICAL ACTIVITY OF RES IN X-IRRADIATED RATS USING ^{131}I-LABELLED ALBUMIN MICROSPHERES. Vitek, F.; Blazek, T.; Dienstbier, Z. (Karlova Universita, Prague (Czechoslovakia). Inst. of Biophysics and Nuclear Medicine). Strahlentherapie; 148: No. 3, 320-325(Sep 1974).

A double-tracer method for determining the proteolytical activity of the RES is presented. The method is based on measurement of whole-body activities of ^{131}I-labelled human serum albumin microspheres and $Na^{125}I$. A mathematical model for estimating the mean permanence time of ^{131}I-microspheres in the cells of the RES as a measure of the proteolytical activity of the RES is described. The method was applied for studying the proteolytical activity of the RES in intact rats as well as rats x-irradiated by a dose of 600 rd. An increased proteolytical activity of the RES was observed in irradiated animals; the mean permanence time of ^{131}I-microspheres in the RES of irradiated animals was 2.09 ± 0.23 days, whereas in intact animals it was 2.9 ± 0.16 days. (auth)

23028 ALTERATION OF THE LIPID COMPOSITION IN ANIMAL ORGANS DIFFERING IN THEIR RADIOSENSITIVITY DUE TO RADIATION INJURY AND UNDER ACTION OF RADIOPROTECTORS. Arkhipova, G. V.; Burlakova, E. B. pp 23-28 of Lipidy v Organizme Zhivotnykh i Cheloveka. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The lipids of the liver, spleen, and brain of BALB line mice irradiated with a lethal dose (650 roentgen) as well of the animals given radioprotectors (3-hydroxypyridine derivatives) were studied by TLC and quantitative densitometry. It has been established that under the effect of irradiation, changes in the content of basic lipid fractions in the investigated tissues are identical in type and time needed to reach extreme values. Direct correlation was shown between quantitative changes in organ lipids and their radiosensitivity. Administration of radioprotectors normalizes the changes observed in animals. (Referativnyi Zh.)

23029 ROLE OF SKIN IN RESTORING REGENERATIVE ABILITY OF X-IRRADIATED NEWT LIMBS. Clarke, B. J. New Orleans; Tulane Univ. (1974). 76p. University Microfilms Order No. 75-2927.

Thesis (Ph. D.).

Studies were conducted in order to determine the role of skin in restoring regenerative ability of irradiated newt limbs. Left forelimbs were irradiated with 2,680R. Non-irradiated skin from the hindlimb was grafted in four ways to irradiated forelimbs, stripped of their own skin: proximal hindlimb skin to the proximal forelimb, proximal hindlimb skin to the distal forelimb, distal hindlimb skin to the distal forelimb, and distal hindlimb skin to the proximal forelimb. The forelimbs were then amputated at a level immediately distal to the skin graft. Thirty-two of thirty-five (92%) irradiated limbs that had received hindlimb skin regenerated. Of those that regenerated, 28.1% were hindlimbs as shown by the presence of five digits; 34.4% had four digits or less; 31.2% had an outgrowth, but no morphogenesis of digits and 6.3% had two hands. Only proximal hindlimb skin grafts were able to promote the formation of single 5 digit regenerates. Cartilage patterns of representative regenerates are described in detail. Hindlimb skin was grafted in the same way to forelimbs of control, non-irradiated animals. All eleven animals regenerated forelimbs. It is concluded that hindlimb skin is capable of restoring regenerative ability of irradiated limbs and that skin carries information for organ structure. For a

second series of experiments left hindlimbs were irradiated with 2,680R and forelimb skin was grafted to these hindlimbs after the hindlimb muscle was removed. Irradiated hindlimbs that had received grafts of forelimb skin produced 5-digit regenerates in 6 of 11 cases (55%). Only 2 (18%) had four digits. The remaining animals (27%) exhibited bud-like regenerates. This suggests that the irradiated limb stump participates in the regenerate in some way. Regeneration times following the different operations were recorded. Both non-irradiated and irradiated stumps, that had received grafts, entered a particular stage of regeneration 7 to 10 days later than untreated stumps. It is concluded that grafting itself is sufficient to delay regeneration. (Diss. Abstr. Int., B)

23030 EFFECTS OF CONTINUOUS GAMMA IRRADIATION UPON CHICK EMBRYOS AT TWO DIFFERENT STAGES OF DEVELOPMENT. DeViney, G. T. College Station, TX; Texas A and M Univ. (1974). 104p. University Microfilms Order No. 75-2845.

Thesis (Ph. D.).

Chick embryos were exposed continuously for different lengths of time to gamma irradiation during organogenesis (0-5 days) and post organogenesis (6-11 days) at rates of 7, 14, and 40 R/hr for a total accumulated dose of 1008 R. One hundred chick embryos in groups of 25 each were exposed at 14 R/hr during organogenesis and post organogenesis development. One group of 25 embryos each were exposed to irradiation at the dose rates of 7 and 40 R/hr during organogenesis and post organogenesis. The embryos were allowed to develop to day 18 of incubation at which time they were removed from the egg and examined grossly and histologically. It was determined that the greatest mortality as well as the frequency and diversity of anomalies occurred in embryos exposed during organogenesis. It was found that all three dose rates of a given developmental age produced similar effects in the exposed embryos. Examination of embryos surviving to day 18 of incubation revealed: that the body weight of embryos irradiated during organogenesis was reduced the greatest of the two developmental ages; the greatest reduction in weight and size of the thyroid, ovary, spleen and testis occurred in embryos irradiated during post organogenesis; some embryos, of the organogenesis group, exhibited reduction of the number of thymus lobes; limited variations in size of the thymus and bursa of Fabricius occurred in embryos exposed during post organogenesis. Histologically the spleen, thyroid and bursa of Fabricius of the two developmental age groups exhibited limited variations from the controls. The testes of both developmental age groups exhibited loss or reduction of spermatogonia and increased cell density of the testicular stroma. The ovaries of both developmental age groups exhibited reduced cortex, poor secondary sex cord invagination and a loss or reduction of oogonia. (Diss. Abstr. Int., B)

23031 HISTOGENESIS OF FETAL RAT LUNG AND LIVER AFTER X-IRRADIATION IN ORGAN CULTURE AND IN UTERO. Vogt, J. C. Corvallis, OR; Oregon State Univ. (1975). 220p. University Microfilms Order No. 75-4548.

Thesis (Ph. D.).

This study compares the effects of exposure to 0 or 435 R of x-ray on the in vitro and in vivo development of fetal rat lung and liver when irradiated at 13, 15, 17, and 19 days of gestation. In one series of experiments organs were irradiated immediately after explanation and cultured for four hours, one or three days. In a parallel series pregnant females were irradiated and the fetal organs were explanted one and three days post-irradiation and cultured four hours. The response of liver explants to culture conditions was variable but the presence of necrosis, fibrinogenesis and decreased hematopoiesis was consistently noted. The events associated with culturing of the liver tended to mask the effects of radiation on its organogenesis. In the method of culture used, fetal lungs grew and differentiated. There was an initial decrease followed by a resurgence in mitosis between one and three days post-explantation. In vitro morphogenesis did not keep pace with lungs developing in utero. Specific departures from normal development observed in organ culture included degeneration of the epithelial lining of the bronchial tree; deterioration of blood vessels; pycnosis; especially in the mesenchyme; and an initial decrease in mitosis. In general, radiation accelerated and magnified the changes associated with culturing. In the organ cultures the effects of irradiation were progressive and irreversible for the first three days post-irradiation. Recovery was observed between one and three days post-irradiation, however in lungs remaining in utero. Connective tissue deposition is a normal event associated with morphogenesis and is accelerated by culturing and further accelerated by x-irradiation. Morphologically the connective tissue synthesized does not appear to be the same between the treatment groups. Biochemical and autoradiographic studies of 15-day fetal lung confirm these histological observations. (Diss. Abstr. Int., B)

23032 THE INFLUENCE OF SINGLE OR FRACTIONATED IRRADIATION OF LIVER WITH X RAYS ON THE FORMATION OF HIPPURIC ACID FOLLOWING SODIUM BENZOATE LOAD IN THE RABBIT. Brandt, F. (Freiburg Univ. (F. R. Germany). Medizinische Klinik). 18 Jul 1973. 59p. (In German). INIS.

13 figs.; 19 tabs.; 36 refs. Available from the library of the Freiburg Univ.

Rabbits received a single or fractionated liver irradiation, percutaneously from the right hand side. Appropriate measures were taken to ensure that the kidneys were not affected by the radiation, and that stomach, spleen, and pancreas were protected as far as possible. Sodium benzoate was applied by injection of a sterilized 10% solution into the vein of the ear. The first injection was given 14 d before the beginning of irradiation, the second 24 h after the last, and the third another 14 d later. The ability of the liver to produce hippuric acid after intravenously applied sodium benzoate (0.5 g/kg body weight) was found to be unaltered 24 h after a single liver irradiation of 2,000 R. Fourteen days after the last irradiation, the production of hippuric acid following application of the benzoate was found to be significantly enhanced. There were no signs of liver damage. (GE)

23033 REPAIR ACTIVITY AND OCCURRENCE OF THE SYNTHETIC PHASE FOLLOWING IRRADIATION WITH X RAYS OR UV RADIATION. Woeltje, M. (Heidelberg Univ. (F. R. Germany). Hautklinik). 11 Jul 1973. 35p. (In German). INIS.

2 figs.; 4 tabs.; 27 refs. Available from the library of the Heidelberg Univ.

The skin of hairless white mice was irradiated with x rays, doses ranging from 20 to 700 R. In another experimental group, the animals were in addition irradiated with uv light from a Xenon source for 30 sec subsequent to x-ray treatment. The epidermis cells were then investigated for repair activity and occurrence of the S-phase detected by means of ^{3}H-thymidine incorporation and autoradiography. The x-ray irradiated specimens showed no difference in repair activity and occurrence of S-phase as compared to non-treated controls. The specimens treated with x rays and uv light showed a clear decrease in repair activity as compared to the specimens irradiated with uv light alone. Comparison of dark controls with x ray and uv-light treated specimens and with those treated only with uv light resulted in markedly lower S-phase values. This depression of the S-phase has to be attributed solely to uv irradiation, as the specimens with combined uv- and x-ray treatment yielded similar results as those subjected only to uv irradiation. The repair activity and occurrence of S-phase as observed within the range given in this thesis do not point to any summation or potentiation effect by either x-ray or uv-treatment. (GE)

23034 STUDIES CONCERNING THE PROLIFERATION KINETICS OF THE KIDNEYS OF RATS AFTER IRRADIATION AND/OR NEPHRECTOMY. P. 2. Histo-Autoradiographic and Histologic Studies. Emminger, A.; Eckel, H.; Kuhn, K. H. (Medizinische Hochschule Hannover (F. R. Germany). Inst. fuer Klinische Radiologie; Medizinische Hochschule Hannover (F. R. Germany). Abt. fuer Experimentelle Pathologie). Strahlentherapie; 148: No. 4, 397-403(Oct 1974). (In German).

6 figs.; 4 refs.

Renal proliferation kinetics were studied both histoautoradiographically and histologically in 180 female Sprague Dawley rats following local irradiation and/or nephrectomy. The marking indices reflecting cyclic tissue proliferation were found to show characteristic maximum and minimum values, which tallied with those obtained by measuring ^{3}H activities during a preceding study. Histological examination revealed enlarged multinuclear tubulus cells in both the cortex and the marrow. The degree of these changes was directly related to the radiation dose and/or additional nephrectomy. The significance of radiation-induced proliferation processes to subsequent systematic carcinogenic treatments is discussed. (auth)

23035 CONDITION OF ENERGY METABOLISM IN THE HEART MUSCLE OF RATS UNDER THE CONDITIONS OF GENERAL RADIATION DISEASE. Movsesyan, M. A.; Arutyunyan, D. E. Zh. Eksp. Klin. Med.; 13: No. 3, 9-15(1973). (In Russian).

On the basis of studies of the concentration of ATP creatine phosphate and the activity of ATP-ase and also of the processes of oxidative phosphorylation (by the polarigraphic method) of heart muscles, the authors concluded that during strong irradiation (doses of 1000 roentgens) in the heart muscle of mice, energetic metabolism occurs slowly and obvious significant changes do not occur due to the formation of cardiovascular deficiencies. (Referativnyi Zh.)

23036 EFFECT OF IRRADIATION ON THE PLASMINOGEN ACTIVATOR CONTENT IN RAT VESSELS. Astedt, B.; Bergentz, S. E.; Svanberg, L. (Univ. of Lund, Malmo, Sweden). Experientia; 30: No. 12, 1466-1467(15 Dec 1974).

Rats were given a single radiation dose of 1000 rad; they were killed after 1 month and after 2 months and the heart, abdominal aorta, and iliac veins were removed. The fibrinolytic activity was determined histochemically. Results indicated that radiation caused a decrease in the activity of cells producing the plasminogen activator enzyme. (HLW)

23037 THE EFFECT OF IRRADIATION ON TRITIUM INCORPORATION IN HAIR. Jaworowski, Z.; Bilkiewicz, J.; Radwan, I. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)). Postepy Fiz. Med.; 8: 169-172(1973). (In Polish).

Incorporation of tritium in the growing hair in rats (Wistar breed) was investigated after administering tritium water in activities between 0.0043 to 40 mCi per animal. The activity of the tritium incorporated in the hair was determined by oxygen combustion and liquid scintillation counting. The degree of tritium incorporation in the hair was found to decrease with the increase in the tritium dose. The effect of external total body and skin irradiation on the tritium incorporation in the hair was also investigated. (auth)

23038 STUDIES ON THE RADIATION PROTECTION PROPERTIES OF FENCHLORFOS AND ITS ROLE IN THE RADIOPROTECTION MECHANISM. Panek, R.; Wisniewski, K.; Sarosiek, W.; Daniluk, J.; Szymanski, A. (Akademia Medyczna, Bialystok (Poland). Zaklad Farmakologii). Postepy Fiz. Med.; 8: 79-85 (1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Radioprotection properties of fenchlorfos were investigated to estimate the survival, radiation toxemia, and metabolic changes that may affect the radioprotection mechanism. (auth)

23039 INFLUENCE OF SOME RADIOPROTECTIVE COMPOUNDS ON POST-IRRADIATION SODIUM METABOLISM. Drozd, S. S.; Burlakova, E. V.; Burdin, K. S. (Moskovskij Gosudarstvennyj Univ. (USSR). Biologo-Pochvennyj Fakul'tet). Biol. Nauki; No. 2, 47-51(1974). (In Russian).

The liquid-scintillation method of determining tagged atoms was used to investigate the distribution of radioactive sodium (^{22}Na) in the kidneys of irradiated mice, who previously had received AET, pyridine, N-oxide of pyridine, N-oxide of 2,6 lutidine and the mixtures: AET + pyridine, AET + N-oxide of pyridine, AET + N-oxide of 2,6-lutidine. Animals not receiving radioprotective compounds and irradiated at a dose of 720 R showed a sharp increase in the amount of ^{22}Na in the kidney. The introduction of radioprotective compounds slowed down the accumulation of sodium in kidney tissue of irradiated animals. (tr-INIS)

23040 X-RAY INDUCED MUTANTS RESISTANT TO 8-AZAGUANINE IN SYNCHRONOUS CHINESE HAMSTER CELLS IN VITRO. Carver, J. H. Fort Collins, CO; Colorado State Univ. (1974). 147p. University Microfilms Order No. 75-4585.

Thesis (Ph. D.).

Synchronous Chinese hamster ovary cells (shake-off mitotic selection) were irradiated in G_1 or S phase. Colony survival in in αMEM medium with dialyzed serum was determined with or without 15 μg/ml 8-azaguanine (8-AG). Both G_1 and S phase were practically identical in sensitivity to X-ray induced mutation, with mutant frequency/locus/rad ranging from 3×10^{-7} (100 rads) to 17×10^{-7} (1000 rads). The spontaneous mutation rate, shown by Luria-Delbruck fluctuation, was 5×10^{-7}. Spontaneous frequencies varied from 1×10^{-6} to 4×10^{-4}. Data indicated that a reproducible assay for the 8-AG system was dependent upon controlling cell density at least two days prior to induction as well as throughout the expression period (elapsed time between induction and drug selection). Generally, spontaneous and induced mutant frequencies decreased when cell densities exceeded $4\text{-}6 \times 10^4$ cells/cm^2. Infrequently, the critical density was exceeded by a factor of two with no observed decrease, apparently correlated with a longer doubling time. Therefore, critical density may depend upon metabolic activity. Drug depletion artifacts, caused by various numbers of cells available to incorporate 8-AG, result in a different spectrum of mutants selected at lower drug concentrations than at higher levels. Refeeding of 8-AG at intervals during the incubation period, compared with non-fed replicates, showed that higher drug concentrations lowered spontaneous and induced frequencies approximately fivefold. Therefore, at the end of the expression time, cells from each dose point were trypsinized and replated at a constant cell number for 8-AG mutant selection. Low density in situ (not replated) points which had density controlled prior to and during the expression period yielded essentially the same dose response for G_1 and S phases. For radiation protection standards, the radiation dose required to induce mutations at a rate equal to that occurring spontaneously is called the doubling dose. The doubling dose reported herein (5×10^{-7} mutations/locus/cell generation divided by 3×10^{-7} induced mutations/locus/cell generation/rad) is 1.7 rads per cell generation. For extrapolation to humans, the induced mutation rate should be compared to the spontaneous rate for several generations of spermatogonia (5×10^{-7} to 5×10^{-6} per locus per reproductive generation). The induced mutation rate in mice for chronic irradiation (more applicable to radiation protection standards) is about ten times lower than acute. With these modifications, the cell culture doubling dose would be estimated at 17 to 170 rads, similar to that of 20 to 200 rads often quoted. (Diss. Abstr. Int., B)

Invertebrates

23041 EFFECTS OF X-IRRADIATION AND CHEMOTHERAPY ON THE HOST-PARASITE RELATIONSHIPS BETWEEN TRIBOLIUM CASTANEUM (HERBST) AND TWO PROTOZOAN PARASITES: NOSEMA WHITEI WEISER AND ADELINA TRIBOLII HESSE. Shinholster, D. L. Ithaca, NY; Cornell Univ. (1974). 156p. University Microfilms Order No. 75-4265.

Thesis (Ph. D.).

The thesis is divided into two parts: the use of x rays as an extra stress factor on the host-parasite interaction between Tribolium castaneum and Nosema whitei to ascertain its synergistic, antagonistic, or neutralistic effects with infection (i.e., nosemosis); and the use of two antibiotic agents, viz., Benlate (Benomyl) and Fumidil B (fumagillin) for testing their potential effectiveness in removing the two parasites, N. whitei and A. tribolii, from the host, T. castaneum. Selected groups of second- and fourth-instar larvae of T. castaneum were starved for 24 hours and, subsequently, exposed to varying dosage levels of Nosema-infected or Adelina-infected media for a period of 48 hours. After inoculation, infected larvae were x-irradiated or chemically treated with either Benlate or fumagillin at varying dosage levels. Following x-irradiation or chemical treatment, all larvae were individually reared in 0.5 dram glass vials containing sterile flour-yeast medium, and observed at two-day intervals until each experiment was terminated. Rearing conditions were maintained at 30°C and 60-70% R. H. The results of this investigation indicate that the effects of x-rays, protozoan pathogens, and chemotherapeutic agents are dependent upon their concentration. The use of low (4000R) and high (8000R) dosage levels of x-irradiation on both uninfected and infected larvae of T. castaneum demonstrated definite deleterious effects upon the beetle. The combined stresses of disease (nosemosis or coccidiosis) and x-irradiation seem to act synergistically in affecting T. castaneum by: increasing mortality; decreasing life span; and producing various morphological abnormalities. X rays at 6000R may have some slight therapeutic effects against small percentages of vegetative forms (i.e., schizonts and zygotes) of both N. whitei and A. tribolii, as represented by the formation of aberrant spores. Benlate, at concentrations from 250 ppm to 500 ppm, was found to be a potentially useful therapeutic agent against N. whitei, but doubtful against A. tribolii. Fumidil B was generally ineffective against both protozoan parasites, but, at the highest dosage level used (i.e., 1000 ppm), occasionally produced aberrant N. whitei spores and A. tribolii sporocysts. (Diss. Abstr. Int., B)

23042 SEXUAL STERILIZATION OF TOBACCO BUDWORMS WITH COMBINATION OF ORAL CHEMOSTERILANTS AND GAMMA IRRADIATION. Guerra, A. A. (Cotton Insects Research Lab., Brownsville, TX). J. Econ. Entomol.; 68: No. 1, 1-3(17 Feb 1975).

Substerile doses (0.01-0.1% w/v) of sulfanilamide, dicumarol, β-sitosterol, 2-imidazolidinethione, and imidazole were incorporated separately into the larval diet of Heliothis virescens (F.), and the resultant pupae were exposed to 7.5 or 15 krad of gamma irradiation. No chemical treatment or irradiation alone was as effective in producing sterile adults as all of the combinations, and none of the combinations affected larval growth and development, adult eclosion, or adult longevity. Although the fecundity of treated females was affected, the number of matings per female was affected only when the males were the treated member of the mating pair. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstracts 22971, 22973, and 24447.

Man

23043 (AED-CONF-74-440-003) DETERMINATION OF RADON EXHALATION FROM BUILDING MATERIAL. Porstendoerfer, J.; Schraub, A.; Wicke, A. (Giessen Univ. (F. R. Germany). Inst. fuer Biophysik). 1974. 11p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e. V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

The radiation exposure due to inhalation of radon and its daughter products is not negligible. The radon concentration (Rn-222 and Rn-220) in a room air is essentially caused by two sources: 1) the diffusion of the emanations from the wall material, 2) the radon exchange with the outer air. The emanations formed from Ra-226 and Ra-224 diffuse out of the wall and ceiling materials so that the special activity of radon in the room air, apart from the exhalation rate, depends also on the ratio of wall surface to room volume and on air exchange. The diffusion constant D of the noble gases was measured in a few building materials with which the exhalation could be determined knowing the radium and thorium concentrations. For this purpose, the wall material sample Q (surface O) was enclosed air-tight in a PVC container and immediately and again after 30 days under the same conditions, the Rn-222 concentration was measured gas-spectrometrically (NaI/Tl) in a whole-body counter. Using the measured Rn-222 activity difference, the diffusion constant and thus the exhalation rate were calculated. (GE)

23044 (COO-3489-2) RADIOCHEMICAL AND RADIOECOLOGICAL STUDIES ON BRAZILIAN AREAS OF HIGH NATURAL RADIATION. Progress Report, July 1973–August 1974. Barcinski, M. A.; Ribeiro, C. C. (Rio de Janeiro Univ. (Brazil). Instituto de Biofisica). 1974. Contract AT(11-1)-3489. 7p. Dep. NTIS $4.00.

A sample from the Guarapari-Meaípe population, living under high levels of natural radioactivity due to the presence of monazite sand in the soil and beaches of the area, was cytogenetically studied. Results showed a statistically significant increase in the yield of total chromosome breaks in the exposed population when compared to a control sample. Considering the low levels of external irradiation to which the Guarapari-Meaípe population is exposed, a hypothesis of internal contamination in this population was made, as possible explanation for the presence of two-break type aberrations. As whole body measurements did not reveal any increase in the radioactive body-burdens in the Guarapari-Meaípe dwellers, a population working with purified monazite was studied, searching for a correlation between the levels of airborne radionuclides and chromosome aberrations. A multiple regression analysis revealed positive correlation between the levels of airborne ^{212}Pb and the yield of dicentric chromosomes in the radioactive ore mill personnel. Considering that the radioactive decay products of ^{212}Pb are high LET emitters, internal contamination with this radionuclide bears a high possibility of increasing the frequency of two-break type aberrations, thus reinforcing the validity of the proposed hypothesis. (auth)

23045 (JAERI-M-5798) REVIEW OF THE PROGRESS IN LUNG MONITOR AND ITS CALIBRATION FOR THE ASSESSMENT OF PLUTONIUM LUNG BURDEN. Shirotani, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1974. 43p. (In Japanese). Dep. NTIS (US Sales Only).

The chances of inhaling ^{239}Pu dust into the lungs may increase with the quantities of Pu handled in laboratories and fuel fabrication plants. From the viewpoint of health physics, determination of the Pu in the lungs is very important, because of the high toxicity of the plutonium. This report reviews the progress made in studies of Pu lung monitors and the calibration of proportional counters and semiconductor detectors during the past fifteen years. In addition, problems encountered in the field and the direction of future studies are given. (auth)

23046 ABSORBED RADIATION DOSE FROM RADIONUCLIDLIC IMPURITIES IN ^{99m}Tc OBTAINED BY DIFFERENT PROCEDURES. Colombetti, L. G.; Barnes, W. E. (Veterans Administration Hospital, Hines, IL). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 455-461 (Oct 1974).

^{99m}Tc, presently the most commonly used radionuclide in nuclear medicine, may be produced in several different ways. It is of great importance to measure the radioactive purity of ^{99m}Tc prepared by the several methods and to assess the extraneous patient radiation dose due to impurities. In this study, original and published data have been combined to compare the radioactive impurities present in ^{99m}Tc produced by elution, MEK (methyl ethyl ketone) extraction, sublimation and cyclotron bombardment. Radioactive contaminants were measured by γ-ray spectrometric analysis using NaI(Tl) scintillators and Ge(Li) solid state detectors. The total body radiation dose to patients was calculated for each impurity identified. The total body radiation dose to patients from impurities in ^{99m}Tc produced by elution, MEK extraction and sublimation techniques was found to be less than 1% due to ^{99m}Tc. In the case of cyclotron production, the impurity radiation dose may be as great as 27% of the dose produced by ^{99m}Tc when a 97% enriched ^{100}Mo target is used. (auth)

23047 HOT SPOTS ON HOT LUNGS. Lancet; No. 7891, 1238-1239(23 Nov 1974).

Published information on the hazards associated with the inhalation of insoluble particles of plutonium is reviewed and related to the recommendations of Tamplin and Cochran (Tamplin, A. R., Cochran, T. B., Radioactive Standards for Hot Particles, National Resources Defense Council, Washington, 1974). The basic controversy is whether radiation damage (e.g. cancer) depends on the size of the dose absorbed per unit volume of tissue (i.e. cell or sub-cellular organelle), on the integrated dose multiplied by the number of cells exposed, or, in fact, on the average dose to the whole organ, which includes populations of irradiated and non-irradiated cells. The observed risk-rates for irradiated people did not substantiate Tamplin's recommendation that the current maximum permissible lung burden needs to be reduced by a factor of 115,000. It is suggested that a statistical survey of the health of men handling plutonium is now needed. The present unsatisfactory emergency medical treatments available for workers accidentally exposed to plutonium are briefly described and some alternative treatments suggested. (UK)

23048 PHENOBARBITONE, LIVER TUMOURS, AND THOROTRAST. Clemmesen, J. (Finseninstitutet, Copenhagen). Lancet; No. 7897, 37-38(4 Jan 1975).

Comments by Dr. Schneiderman (Lancet, 1974, Nov. 2, 1085) on Danish statistical data on cancer in epilepsy patients (Clemmensen, J., Frederiksen, V. F., Plum, C. M., Lancet, 1974, i, 705) are assessed by one of these authors. Dr. Schneiderman's interpretation suffered because of the necessary brevity of the published statistical details, andl also his application of generalizations from American experience to Danish data. Under-reporting of deaths ascribed to one cause in a population known to have another, sometimes fatal, disease does not occur in efficient research hospitals. Danish statistics showing parallel incidences of cervical uterine cancers and breast cancers in different populations are at variance with Dr. Schneiderman's assumption that a low cervical rate is usually associated with a high breast cancer rate. The slight excess of cancer of the liver in epileptics treated with anticonvulsants for more than ten years was not statistically significant, and in addition the cases (4 males, 1 female) included three male patients who had received radiation doses from "Thorotrast" (thorium dioxide), as well as the long-term administration of phenobarbitone. The validity of the conservative statement that no evidence was found that phenobarbitone was oncogenic when given to epileptics in high doses for more than a decade is therefore upheld. (UK)

23049 SUMMARY OF CURRENT RADIATION DOSE ESTIMATES TO HUMANS WITH VARIOUS LIVER CONDITIONS FROM ^{198}Au-COLLOIDAL GOLD. J. Nucl. Med.; 16: No. 2, 173-174 (Feb 1975).

Dose estimates based on computer calculations of nuclear data applicable to ^{198}Au-colloidal gold prepared commercially for routine clinical studies are presented. Estimates were solicited for the percentage localization of ^{198}Au after a single intravenous injection of ^{198}Au-colloidal gold to normal patients and to those with either early-to-intermediate or intermediate-to-advanced diffuse parenchymal liver disease. The sites of ^{198}Au localization were assumed to be liver, spleen, red marrow, and the rest of the body. It was also assumed that no ^{198}Au was excreted from the body. (CH)

23050 THEORETICAL CALCULATION OF THE EXPOSURE RATE CONSTANT FOR RADIUM-226. Payne, W. H.; Waggner, R. G. (Univ. of Texas, San Antonio). Med. Phys.; 1: No. 4, 210-214(1974).

Until recently, the photon spectrum of ^{226}Ra has not been known with sufficient accuracy to permit calculation of the exposure rate constant. Workers concerned with calculations involving this constant have relied upon measured values. The authors have taken compiled photon spectra authored by M. J. Martin and P. H. Blichert-Toft in Nuclear Data Tables along with photon cross sections authored by E. Storm and H. Israel in Nuclear Data Tables and calculated theoretical values for the exposure rate constant for ^{226}Ra. Using the most recent 72-line spectrum for ^{226}Ra and its daughter products, an exposure rate constant of 12.44 R-cm^2/mg-h was obtained for unfiltered radium. A large portion of this value was contributed by some low energy x-ray lines which would not be seen in even a very lightly filtered source. Using a 3-mm-o.d. sphere (90%-Pt, 10%-Ir, 0.5-mm filter), a value of 8.12 R-cm^2/mg-h was obtained for the filtered

source. Primary, scattered, and bremsstrahlung contributions to this value were 7.610, 0.363, and 0.149, respectively. This value is within 1.6% of the presently accepted value for ^{226}Ra, 8.25. (auth)

23051 DOSIMETRY OF SPHERICAL $^{90}Sr-^{90}Y$ β RAY EYE APPLICATORS. Supe, S. J.; Millikarjuna Rao, S.; Sawant, S. G. (Bhabha Atomic Research Centre, Bombay). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 36-41(Jan 1975).

A modification of the conventional extrapolation chamber to perform absolute dose measurements from surfaces of spherical β applicators (type SIA.I, SIA.3, SIA.6) is described. A stack of Ilford N 550 films was used in a spherical geometry to obtain the variation of surface dose, the depth dose data and the isodose curves. The results obtained are compared with data available in the literature. (auth)

23052 RADIUS-DOSE RELATIONSHIP IN LINEAR SOURCE THERAPY. Morrison, R. A. (Univ. of Kansas, Kansas City). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 179-181(Jan 1975).

The rationale and physical data are presented that support the hypothesis that the tolerance dose on the surface of a cylindrical applicator containing a central linear source is inversely proportional to the cube root of its radius. (auth)

23053 IODINE-125 SOURCE IN INTERSTITIAL TUMOR THERAPY: CLINICAL AND BIOLOGIC CONSIDERATIONS. Kim, J. H.; Hilaris, B. (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 163-169(Jan 1975).

From 56th annual meeting of the American Radium Society; New York, NY (21 Apr 1974).

Clinical experience with interstitial tumor therapy is presented in 2 groups of patients: 98 patients with metastatic carcinoma in neck lymph nodes implanted with iodine 125, iridium 192 or radon 222 encapsulated sources, and 105 patients with primary unresectable lung tumors, which were implanted either with radon 222 or iodine 125 seeds. The local tumor control rates with iodine 125, radon 222 and iridium 192 were 78 per cent (38/49), 65 per cent (15/23) and 58 per cent (7/12), while the local complication rates were 17 per cent, 35 per cent and 43 per cent, respectively. An analysis of the tumor control rate as a function of the implanted tumor dose shows that the iodine 125 implants with a delivery of the minimal effective tumor dose of 16,000 rads have a higher therapeutic effect than either radon 222 or iridium 192. The results of the patients with unresectable lung tumors similarly show that the implants with iodine 125 sources are superior to those with radon 222. The advantages could stem from the better spatial dose distribution, and from radiobiologic considerations associated with low dose rates, continuous irradiation, and possibly gains in RBE. The present clinical data clearly demonstrate that iodine 125 seeds have a higher therapeutic ratio than radon 222 seeds. There are, in addition, distinct physical advantages making iodine 125 an attractive substitute for radon 222 for the interstitial implantation of malignant tumors. (auth)

23054 CALIBRATION FOR INHALED RADIOACTIVE MATERIAL USING A POINT SOURCE. Falk, R. B. (Dow Chemical Co., Golden, CO). Health Phys.; 27: No. 6, 557-563(Dec 1974).

A method has been developed to calibrate for the measurement of inhaled radioactive material using a point source. The method involves a lung model which describes the lung and chest of an exposed person by a set of parameters. This lung model is used to adjust the calibration to include considerations of body stature and chest thickness. The development of the method is presented, and advantages and limitations of the method are discussed. (auth)

23055 THE ANALYSIS OF DOSE DISTRIBUTIONS FROM ^{226}Ra APPLICATORS USED IN A MODIFIED PARISIAN METHOD OF TREATING CERVIX UTERI CARCINOMA. Dzikiewicz-Sapiecha, H.; Majenka, I.; Bulski, W. (Instytut Onkologii, Warsaw (Poland)). Postepy Fiz. Med.; 8: 213-218(1973). (In Polish).

Dose distributions from Ra-226 applicators used in the Oncology Institute, Warsaw, in the therapy of cervix uteri carcinoma were determined theoretically. The analysis of the dose distributions was carried out to evaluate the clinical applicability of the applications used. The knowledge of the dose distributions is essential in planning the supplementary treatment with external beams of x rays and Co-60 gamma rays. (auth)

23056 ANALYSIS OF DOSE, DOSE-RATE, AND TREATMENT TIME IN THE PRODUCTION OF INJURIES BY RADIUM TREATMENTS FOR CERVICAL CARCINOMA. Lee, K. H. Los Angeles; Univ. of California (1974). 191p. University Microfilms Order No. 75-2229.

Thesis (Ph. D.).

A retrospective study of a small sample of radiation injury cases utilizing computer assisted dosimetry was carried out. The three dimensional dose distributions as calculated by the computer were used to estimate the maximum radium doses to 15 injured and non-injured bladders, rectums, and ureters. In order to analyze the data, the maximum dose to each organ was plotted on a time-dose plot and a best separation line was calculated. It was found that the radium treatment protocols used in Stockholm, Manchester, and Houston which collectively represent a great deal of clinical experience all fall near the separation line. Nevertheless, the best separation curve provides a poor separation of the two sets of points representing respectively the injured and non-injured organs. The separation becomes tremendously improved, however, when the same data are re-plotted in a dose versus dose-rate plane. It appears therefore that a Strandqvist type dose-time plot is inadequate for injury analysis in radium therapy. The dose-rate to the injured tissue is more important than the overall treatment time in predicting damage to normal tissues by a given dose of radiation. This result is consistent with the findings in radiation biology. The same analytic methods were extended to 50 documented cases of radiation injury in Stockholm. Dosimetry for these 50 cases had been obtained from direct ionization chamber measurements in the bladder and rectum. Separation lines on either dose-time or dose versus dose-rate plots poorly separate the two sets of points representing the injured and non-injured organs respectively. This discrepancy with my results may be explained as follows. Computer assisted radium dosimetry shows that in a region of high dose-rate, there is always a steep dose-rate gradient. If the reported chamber measurements are average values over a relatively large region of measurement, a common practice, the reported dose and dose-rates are not the maximum values to the affected organs. My results show a good separation of injured from non-injured cases only when the maximum values of dose and dose-rates are used. This in turn implies that relatively small hot spots—regions of high dose and dose-rate—can become the foci for clinically significant radiation injury. The maximum doses calculated from the three dimensional isodose plots constructed for the 15 patients used in the dose-time study were compared with the point doses that had been entered in the patients charts at the time of therapy to see whether the computer dosimetry is more likely to reveal potential serious damage to normal tissue than the limited hand calculations in the charts. The comparisons show many large discrepancies. A major reason for this probably is that the regions of maximum dose-rate are clearly displayed in the computer isodose plots, whereas the tedium of carrying out hand calculations forces the dosimetrist to make only limited guesses at the position of the potential hot spots. (Diss. Abstr. Int., B)

Animals

Refer also to abstracts 22637 and 23011.

23057 (AED-CONF-74-421-003) OSTEOSARCOMAS AND AGE-DEPENDENT SKELETAL CHANGES IN MICE AFTER INCORPORATION OF SHORT-LIVED ALPHA-EMITTERS (^{224}Ra, ^{227}Th). Luz, A.; Goessner, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany)). 1974. 11p. INIS.

From 10th international congress of the International Academy of Pathology; Hamburg, F. R. Germany (16 Sep 1974).

The late effects of ^{224}Ra and ^{227}Th in NMRI and C3Hx 101 hybrid mice were studied following i.p. injections of the radionuclides as isotonic solutions. Autopsy was performed on all animals which died or were killed in a moribund state. A maximum osteosarcoma incidence of 10 to 20% was observed in female NMRI mice after single injections of ^{224}Ra corresponding up to 1,500 rads mean skeletal dose. The dose-dependent increase of osteosarcomas in males is lower with a maximum being below 10%. The osteosarcoma risk in female NMRI mice is considerably higher with ^{227}Th than with ^{224}Ra. With 1,000 rads mean skeletal dose the incidence is about 60%. The skeletal distribution of the radiation-induced osteosarcomas is dose-dependent to a certain degree. Fractionation of the injected dose caused a steady increase of bone tumor risk. A detailed histological analysis of the entire skeleton from some animals revealed areas with highly atypical cells. After injection of ^{227}Th into C3H hybrid mice an age-related osteoporosis was observed. In older mice also areas of hypostosis were found. The findings in C3H mice were mostly similar to those obtained with NMRI mice. (GE)

23058 RAT MAMMARY NEOPLASIA FOLLOWING DEPOSITION OF PLUTONIUM. Sanders, C. L. Jr. (Battelle Pacific

Northwest Labs., Richland, WA). Health Phys.; 27: No. 6, 592-593(Dec 1974).

Mammary tumors in many strains of female rats occur spontaneously with a high incidence. An analysis of mammary gland neoplasia was carried out in Sprague-Dawley, female rats following inhalation of a soluble form of ^{238}Pu or following intraperitoneal injection of PuO_2 particles; and in Wistar, female rats following intratracheal instillation or intrapleural injection of $^{239}PuO_2$ particles. It is concluded that deposition of < 1 μCi Pu/kg body weight in female rats does not result in an increased incidence of mammary tumors irrespective of the method of plutonium administration or the solubility of the plutonium compound. Results differing significantly from controls were confined to rats injected with $^{238}PuO_2$, due probably to the high rate of in vivo solubilization of ^{238}Pu and its translocation to mammary tissue. Tissues that undergo rapid proliferation and increase in mass, such as in mammary tumors, may be expected to accumulate ^{239}Pu that is slowly being solubilized and released to the blood, from which it is removed by the tumor. (UK)

23059 COLLAGEN BIOSYNTHESIS IN RAT LUNGS IN RADIATION INJURY. Tseveleva, I. A. Vop. Med. Khim.; 20: No. 6, 640-643(1974). (In Russian).

An increase in collagen biosynthesis rate was found in lungs at very early steps of the process of sclerotic alterations, caused by plutonium α-radiation. Both an increase in content of soluble collagen fractions in lungs and stimulation of ^{3}H-proline incorporation into collagen were demonstrated. (auth)

23060 EFFECTS OF PuO_2 PARTICLES DEPOSITED IN THE LUNG FOLLOWING INTRAPERITONEAL INJECTION. Sanders, C. L. Jr. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 28: No. 1, 84-86(Jan 1975).

The uptake and effects of plutonium in lung following the intraperitoneal injection of PuO_2 in rats is reported. 172 female rats each received between 72 and 2900 nCi $^{239}PuO_2$ as a single injection. Autoradiograms and histological sections were examined for Pu distribution and pathological changes. Discrete PuO_2 particles were scattered randomly in the lung parenchyma, most of the particles appearing within alveolar septae. No change in the pattern of PuO_2 distribution was seen over a period from 1 month to 2 yr after injection, except for greater numbers of particles accumulating with time, in the lungs of rats from the highest dose group. There was no subpleural concentration of PuO_2 particles, such as is seen after inhalation of PuO_2. There was surprisingly little evidence of pulmonary pathology that could be attributed to PuO_2 deposition including the absence of alveolar fibrosis, hyperplasia or metaplasia in tissues immediately surrounding the sequestered PuO_2 particles. Only one lung tumor was found in all the groups, an alveolo-bronchiolar adenocarcinoma at 823 days after injection of 72 nCi PuO_2. It is concluded that the lower carcinogenicity of PuO_2 particles sequestered in the alveolar septae following their intraperitoneal injection, is probably due to their immobility and consequent irradiation of fewer epithelial cells in the lung, than would be the case with inhaled PuO_2 particles. (UK)

Plants

23061 EFFECT OF ^{14}C RADIATION ON CERTAIN PHYSIOLOGICAL AND BIOCHEMICAL ASPECTS OF PLANT METABOLISM. Veluswami, K. S. Toronto; Univ. of Toronto (1971). 189p.

Thesis.

Fifteen day old barley seedlings grown in pots under controlled conditions were fed with graded levels of $^{14}CO_2$ viz. 0.2, 0.4, 0.6, 0.8, and 1.0 mCi/g fresh weight of shoot. The above doses yielded varying morphological, biochemical, and physiological changes in the shoots of the plants within 10 days after initiation of the treatments. The samples, collected at 2 day intervals were used for various analyses. Several morphological changes, viz. chlorosis, stunted growth, lack of turgidity, and marginal drying of the leaves were noticed. Fresh weight and water content of the treated plants generally decreased with increasing dosage and time. Dry weights of shoots increased. General inhibition in growth as measured by fresh weight was attributed to the cumulative effect of ^{14}C-radiation in the meristematic region of the shoots. The increase in dry weight of the shoots was considered to be due to prevention of translocation of photosynthates to the roots and accumulation in the shoot itself. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 23043, 23047, and 23113.

23062 RENAL LOCALIZATION OF ^{67}Ga CITRATE. Frankel, R. S.; Richman, S. D.; Levenson, S. M.; Johnston, G. S. (National Institutes of Health, Bethesda, MD). Radiology; 114: No. 2, 393-397(Feb 1975).

Renal localization of ^{67}Ga citrate was observed in 1.7% of 2,000 whole-body gallium scans in three major diseases: lymphoreticular neoplasms, leukemia, and malignant melanoma. Correlation of this finding with autopsy data in 13 cases revealed 9 with tumor and 2 with an inflammatory process. Findings in two cases were normal. In the remaining patients, correlation with abnormal urograms and laboratory data was poor. Nevertheless, gallium localization in the kidneys may be the first indicator of renal involvement with either tumor or inflammation. (auth)

23063 EXPERIENCES ON RADIUM INCORPORATION IN HUNGARY. Bozoky, L. (Orszagos Onkologiai Intezet, Budapest). Izotoptechnika; 17: No. 9-10, 501-503(1974). (In Hungarian).

Methods of measuring radium incorporation were developed. Data were based on 15 cases. Data from the first rapid excretion period could not be obtained. The second exponential period showed an effective half-life of 16 years. (auth)

23064 ACCIDENTAL INHALATION OF MERCURY-203. Brown, K. W.; McFarlane, J. C.; Bernhardt, D. E. (National Environmental Research Center, Las Vegas, NV). Health Phys.; 28: No. 1, 1-4(Jan 1975).

Two employees were inadvertently exposed to radioactive ^{203}Hg through inhalation. Whole-body content of ^{203}Hg decreased with an effective half-life 16.6 ± 0.6 and 17.5 ± 2.0 days and a biological half-life of 25.8 ± 1.1 and 27.9 ± 3.7 days. Urine collected during a portion of this study indicated that about 29% of the mercury was excreted via the urine. Calculations based on the Model of the ICRP Task Group on Lung Dynamics, indicated that kidney doses for the two personnel exposed were from 110 to 170 and 13 to 21 mrem respectively. (auth)

23065 STUDY OF CERTAIN CHARACTERISTICS OF STRONTIUM METABOLISM IN A HOMOGENOUS GROUP OF HUMAN SUBJECTS. Likhtarev, I. A.; Dobroskok, I. A.; Ilyin, L. A. (Leningrad Inst. of Radiological Hygiene). Health Phys.; 28: No. 1, 49-60(Jan 1975).

Results of a study of ^{85}Sr metabolism in 44 healthy young men aged 23 ± 2 yr are presented. During the 3 to 6 months after intravenous injection (eight human subjects) or oral administration (36 human subjects) of the label, retention of ^{85}Sr in the organisms was measured. During the 5 to 8 days following administration values of the complete ^{85}Sr excretion were studied. The coefficient of absorption of ^{85}Sr from the GI tract into the blood stream was estimated to be 28 ± 2.5. Data on ^{85}Sr retention in the organism of normal young men for the time period of 3 to 6 months following the injection may be approximated by the following equation: $R(t) = (0.79 \pm 0.05)t^{-(0.18 \pm 0.04)}$. The comparison of the results obtained in the present research with the data of other authors has been made. (auth)

23066 RETENTION AND EXCRETION CURVES OF PERSONS CONTAINING ^{90}S AND ^{226}Ra AFTER A CHRONIC CONTAMINATION. Wenger, P.; Soucas, K. (Service Cantonal de Controle des Irradiations, Geneva). Health Phys.; 28: No. 2, 145-152(Feb 1975).

A woman dial painter born in 1930 was exposed to ^{226}Ra intake from October 1946 to October 1963 and to ^{90}Sr intake from May 1956 to May 1959. Her husband, born in 1929, was exposed to ^{226}Ra from August 1952 to October 1963 and to ^{90}Sr from May 1956 to May 1959. Total body counting during the interval 1963 to 1971 indicated that the effective retention half-times were about 3200 days for ^{90}Sr and 5500 days for ^{226}Ra in the woman, while corresponding values in the man were about 3300 days for ^{90}Sr and 2700 days for ^{226}Ra. (auth)

23067 SIGNIFICANCE OF THE RADIOSTRONTIUM ACCUMULATION IN THE AXIAL SKELETON FOR THE CLASSIFICATION OF STAGE OF THE MAMMARY CARCINOMA. Schoen, D. (Staedtisches Auguste-Viktoria-Krankenhaus, Berlin-Schoeneberg (F. R. Germany). Strahlenabteilung). Therapiewoche; 24: No. 42, 4829-4832(Oct 1974). (In German).

The activity picture of radiostrontium in the axial skeleton in the form of profile curves was recorded at the beginning of the post-operative telecobalt irradiation of 200 women with mammary carcinoma. 107 women could be controlled for more than 1 year. In the UICC stage I, only about 90% of the women had an inconspicuous radiostrontium profile; in stage II it was about 60%, and in stage III only 55% in the non-selected women investigated. The problems of the specificity of the investigation method is discussed. It is warned against the inclusion of women with positive radiostrontium profile in the therapeutic success statistics. (GE)

23068 FATE OF INHALED RADON PROGENY. Alexander, D. R. Fort Collins, CO; Colorado State Univ. (1974). 87p. University Microfilms Order No. 75-4579.

Thesis (Ph. D.).

A shadow shield whole body counter and linear scanning techniques were used to determine the deposition and translocation of inhaled radon (^{220}Rn) progeny in volunteer experimental subjects. The inhalation atmosphere was produced by combining nebulizer produced NaCl aerosol in a size range from 0.033 μm to 0.088 μm with ^{220}Rn progeny generated from a ^{228}Th solution. Total deposition percentages of 68% and 36% were determined for 0.033 μm and 0.073 μm aerosol respectively. An average of 54% of the deposited aerosol was found in the pulmonary region. Movement of deposited radioactivity from the respiratory tract is clearly shown to be a function of particle size. Aerosols in a size range from 0.068 μm to 0.088 μm were shown to have a biological half life of approximately 20 hours in the pulmonary region while the 0.033 μm aerosol had a biological half life of nearly 60 hours for the same region. A distinct difference in biological half life was shown between the pulmonary and tracheobronchial regions. (Diss. Abstr. Int., B)

23069 CLINICAL USEFULNESS OF DETERMINATION OF HALF-TIME OF DECAY OF RADIOACTIVE ROSE BENGAL (CBJ-131) IN BLOOD IN ASSESSMENT OF LIVER FUNCTION. Pirwitz, B. (Centrum Medyczne Ksztalcenia Podyplomowego, Warsaw (Poland)). Wiad. Lek.; 26: 1211-1217(1973). (In Polish).

Determinations of liver function using radioactive rose bengal were carried out in 91 subjects including 19 healthy controls and 72 cases with various diseases. A modification of the test was used with direct determination of the half-time of decay of labelled rose bengal in blood samples. The value of the radioisotope test was compared with traditional liver function tests and with the test with indocyanine green. Liver biopsy was done in 83.3% of cases. Determinations of half-time of decay in the blood is a very sensitive test of liver function in chronic liver diseases. (auth)

Animals

Refer also to abstracts 23037, 23058, and 23060.

23070 (CEA-CONF-2840) KINETICS OF SELENOMETHIONINE ^{75}Se IN THE RAT. Cohen, Y.; Merlin, L.; Lambert, F.; Martinelli, M.; Bruneau, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1974. 3p. (CONF-740926-7). Dep. NTIS (US Sales Only) $4.00.

From 1st world congress of nuclear medicine and exhibition meeting; Tokyo, Japan (30 Sep 1974).

The kinetics of ^{75}Se distribution and excretion in rats following the intravenous injection of ^{75}Se-selenomethionine were measured. (CH)

23071 (CEA-N-1764) INFLUENCE OF THE CONCENTRATION OF STABLE CESIUM IN SEA-WATER ON THE CONTAMINATION OF ARENICOLA MARINA L. (ANNELID-POLYCHAETE) BY CESIUM-137. Amiard-Triquet, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection; Nantes Univ., 44 (France)). Nov 1974. 27p. (In French). Dep. NTIS (US Sales Only) $4.50.

The contamination of Arenicola by ^{137}Cs was studied in nine experimental and one control lots. The results were processed using several techniques of factorial analysis. The part played by the concentration of stable cesium on the contamination by ^{137}Cs of the living organisms is discussed, taking account of previous experiments. (auth)

23072 (CEA-R-4630(2-3-4)) STUDY OF THE ACCUMULATION OF SOLUBLE AND INSOLUBLE FORMS OF ^{59}Fe BY MARINE MOLLUSC AND FISH (MYTILUS EDULIS AND BLENNIUS PHOLIS). II. Relations Between Contamination Processes and Growth Stages. III. Accumulation in Various Organs as a Function of the Physico-Chemical Forms of the Radionuclide. IV. Decontamination Process of Individuals After Uptake of Either Physico-Chemical Form. Fraizier, A. (CEA Centre de La Hague, 50-Cherbourg (France). Service de Recherches Toxicologiques et Ecologiques). Jan 1975. 31p. (In French). Dep. NTIS (US Sales Only) $4.75.

The concentration by two marine species: mussels (Mytilus edulis) and fish (Blennius pholis), of soluble and insoluble forms of ^{59}Fe in seawater was studied experimentally. An inverse correlation was found between the contamination of individuals and their growth, which meant it must be linked to the metabolic activity of mussels and blennies and confirmed that exchanges between species and contaminant, whatever its physicochemical form, were greatly related to physiological processes. Uptake was generally more important at the level of organs involved in nutrition and respiration. A comparison of the contaminating power of ^{59}Fe soluble and insoluble forms respectively showed that the latter were always more contaminating, in proportions varying with the organs. This uptake seemed enhanced at the level of the mantle and the adduction muscle in mussels and of the skin in blennies, and suggested the occurrence of passive adsorption processes. In both species decontamination showed two stages at least, a faster one (2 to 4 days) and a secondary one, usually very slow. In mussels, iron complexed by EDTA had a faster passage than the insoluble forms, with a biological half-life of about 15 days. (auth)

23073 (CNAEM-R-134) COMPARISON OF ^{65}Zn LOSS-RATE OF MYTILUS GALLOPROVINCIALIS DETERMINED IN THE FIELD AND LABORATORY CONDITIONS. Uenlue, M. Y. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1974. 8p. (CONF-741233-1). Dep. NTIS (US Sales Only) $4.00.

From 24th plenary congress assembly on marine radioactivity; Monaco (6 Dec 1974).

Experiments on the loss rate of ^{65}Zn by Mytilus galloprovincialis in the laboratory and in the field were carried out. It was concluded that the results obtained in the field and laboratory can be comparable if the physical and chemical conditions in the field are not changed very frequently. (auth)

23074 USE OF KINETICS OF ^{22}NA TO ESTIMATE THE FOOD CONSUMPTION OF SITOPHILUS GRANARIUS IN DIFFERENT TEMPERATURE AND FEEDING CONDITIONS. Buscarlet, L. A.; Lasceve, G.; Garcin, J. (CEN de Cadarache, Saint-Paul-les-Durance, France). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 445-453(Oct 1974). (In French).

From the literature data, the biological half-life of radioisotopes in insects approximatively obeys the same laws as those governing the metabolism. In order to ascertain this phenomenon, ^{22}Na elimination and respiration were investigated for several batches of Sitophilus granarius placed in different conditions of temperature and nutrition. After an extensive study of the steady dynamic state of the system, the following results are obtained. From the Q_{10} calculated for the turnover rate, the results confirm that the elimination varies in the same way as the respiration. However, between 16 and 22°C, the Q_{10} value is significantly higher than between 22 and 29°C (5 and 2 respectively). From the daily food consumption estimated from the tracer kinetic analysis, it is shown that this method can be applied to any species able to regulate its sodium content in a given period. (auth)

23075 COMPARATIVE EFFECTS OF ACETAZOLAMIDE AND PRUSSIAN BLUE ON ^{137}Cs RETENTION IN THE RAT. Ducousso, R.; Causse, A.; Pasquier, C. (CEN, Fontenay-aux-Roses, France). Health Phys.; 28: No. 1, 75-78(Jan 1975).

Results of an experiment to compare the effect of acetazolamide (Diamox), colloidal Prussian Blue, and an association of both, on ^{137}Cs retention and urinary and fecal excretion in rats, are reported. Retention in the rats that had received Prussian Blue only was significantly different at the 95% confidence level from the retention observed for rats receiving Diamox; but retention in the rats having received Prussian Blue only is not significantly different from the retention in those that received Diamox and Prussian Blue together. Also that treatment by Diamox in addition to Prussian Blue enhanced urinary excretion but decreased fecal excretion, the residual body burden remaining fairly unchanged. It is concluded that the sites of action of the two agents are different, as previously reported, but their effect is not cumulative. It is therefore suggested that, owing to its effectiveness and innocuity, Prussian Blue seems to be now the right treatment for internal contaminations by radioactive cesium. (UK)

23076 METHOD FOR INVESTIGATING THE METABOLISM OF THE TRANSPORTABLE FRACTION OF PLUTONIUM AEROSOLS. Stather, J. W.; Howden, S.; Carter, R. F. (National Radiological Protection Board, Harwell, Eng.). Phys. Med. Biol.; 20: No. 1, 106-124(Jan 1975).

The metabolism of the transportable fraction of both soluble and insoluble forms of plutonium following their deposition in the respiratory system of the rat by either inhalation or pulmonary intubation was investigated. The results showed that the transportable fraction varied considerably with the chemical form of the plutonium. Thus at one week after the pulmonary intubation of a solution of plutonium citrate, the extrapulmonary tissue deposit was 69% of the initial pulmonary deposit while in the case of a suspension of plutonium dioxide the corresponding value was only 0.075%. However, the metabolism of plutonium following its entry into the systemic circulation was largely independent of the original chemical form deposited in the lung. The liver accumulated only about 16% of the activity deposited in tissues from the blood, implying that plutonium was circulating in the blood predominantly in a monomeric form. The cumulative excretion of plutonium in the urine over the first week after pulmonary

deposition as either the dioxide, citrate, or nitrate was lent to about 4.5% of the extrapulmonary tissue deposit and the results suggested that this value could be used as a basis for calculating the activity deposited in tissue from the blood in man. This study also demonstrated that mixed aerosols of plutonium dioxide and sodium oxide are more transportable in the lung than aerosols of plutonium dioxide alone. A maximum transportability was reached at Pu:Na atomic ratio of about 1:20, when the transportable fraction of plutonium was forty-five times that from a plutonium dioxide aerosol alone. (auth)

23077 ABSORPTION FROM THE GUT OF A SUSPENSION OF PLUTONIUM–SODIUM AEROSOL. Brightwell, J. (National Radiological Protection Board, Harwell, Eng.); Carter, R. F. Health Phys.; 28: No. 2, 156-158(Feb 1975).

Approximately 250 nCi of an aqueous suspension of a plutonium-sodium aerosol produced by an exploding wire technique was administered to 20 anesthetized female rats by gastric intubation. The lung, gut, liver, and bones were analyzed for ^{239}Pu content in pairs of rats sacrificed serially over 24 hr. The results of liver and skeletal analyses are shown from which it is seen that there is little further increase in the total quantity of plutonium taken up by liver and bone after 9 hr and the partition of the absorbed plutonium between these two organs, with the liver containing about 16% of this total, is similar to that found for monomeric plutonium. The average transport of plutonium to liver and bone one day after intubation was 1×10^{-2}% of that administered. This figure compares with 3×10^{-3}% suggested by ICRP as the proportion of ingested soluble plutonium absorbed from the gut into the blood stream; the comparable figure for insoluble plutonium being 1×10^{-4}% (International Commission on Radiological Protection. (1972). Publication 19. Oxford. Pergamon Press). It therefore appears that the plutonium-sodium aerosol used in this experiment behaves more like a soluble form of plutonium with a gut uptake of about 100 times that suggested for an insoluble form. (UK)

23078 INFLUENCE OF SALINITY AND IONIC EQUILIBRIUM ON THE CONTAMINATION OF ARENICOLA MARINA L. (ANNELIDA POLYCHAETA) BY CAESIUM-137. Amiard-Triquet, C. (Institut des Sciences de la Nature, Nantes, France). J. Exp. Mar. Biol. Ecol.; 15: No. 2, 159-164(Jun 1974). (In French).

The fixation of ^{137}Cs on fine sand with Arenicola increases when the salinity or the K content of water is decreased. The contamination of Arenicola by ^{137}Cs was, therefore, higher than in normal sea water. The concentration factors for sea water diluted to 60% or with a K level of 50% were twice those for normal sea water, except for the coelomic fluid, the concentration factor of which remained constant. Several assumptions can explain the process: 1) a weaker competition between ions at the lower concentrations; 2) substitution of potassium by cesium; 3) parallel contribution of Cs and K in maintaining the internal environment more hypertonic than the external environment; and 4) contamination via the food chain in desalinated sea water. (auth)

23079 USE OF SOLID STATE MINIATURE DETECTORS FOR STUDY OF ALKALINE EARTH METABOLISM IN RAT ORAL BONE. Porter, V. L.; Marcus, C. S.; Stahl, S. S. (Univ. of Southern California, Los Angeles). Int. J. Nucl. Med. Biol.; 2: No. 1, 5-12(Jan 1975).

The usefulness of miniature solid state detectors for the study of the dynamics of alkaline earths in normal, stressed, and injured rat oral bone has been demonstrated. Silicon avalanche and lithium-compensated solid state detectors were used in the present investigation. Concurrently, the advantage of using short-lived radionuclides is stressed, especially in cases when repeatable dynamic studies are required. In a first series of experiments the rate of ^{45}Ca uptake in rat's oral bone was determined at 3-hr interval after intravenous administration of the radionuclide. After a stress exerted on normal oral bone, the highest uptake was found in the maxillary alveolar plate. Lesser uptakes were recorded in the alveolar ridge and the lowest values were noted in the palatine process. There appeared to exist a correlation between the rate of radionuclidic uptake and the degree of functional stress applied to the area. Another series of experiments explored the rate of remineralization of specifically injured and healing maxillary alveolar ridges. The short-lived ^{87m}Sr was used and its uptake was monitored with a Si(Li) solid state detector over the wound as well as over the contralateral site. The rate of radionuclidic incorporation was measured up to 3 weeks after wounding. A peak in uptake over the wound site occurred about 2 weeks after injury, correlating with the known physiological data on bone remineralization during healing. The data obtained with the short-lived ^{87m}Sr were confirmed with other experiments with ^{85}Sr and subsequent radioactivity assay with gamma ray detection in a NaI(Tl) crystal well counter. (auth)

23080 BIOLOGICAL INVESTIGATION ON THE DISTRIBUTION OF ^{67}Ga-CITRATE IN RATS IN RELATION TO SEX AND METHOD OF APPLICATION. Heidenreich, P.; Kriegel, H.; Hoer, G. (Technische Univ., Munich). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 557-565(Dec 1974). (In German).

The biological reaction of carrier-free ^{67}Ga-citrate was examined in the rat with regard to sex and method of application. The following results were obtained: (1) There is a definite relationship in the distribution of Ga in the organs according to the method of application (i.v. or s.c.). The blood concentration is reduced after s.c. injection up to 12 days p.i. (2) According to sex, a significant difference in the distribution of carrier-free Ga-citrate was established in blood, liver, spleen, kidney, and muscle. The blood, liver, and kidney of the female animals showed, during the time of observation, a significantly higher radiogallium content, whereas muscular tissue and spleen revealed a lower content than the corresponding organs of the male rats. (3) Excretion of Ga-citrate was mainly renal during the first 12 hrs; later excretion through the intestinal tract dominated. (auth)

23081 EFFECT OF CHEMICAL FORM ON THE CLEARANCE OF 239-PLUTONIUM FROM THE RESPIRATORY SYSTEM OF THE RAT. Stather, J. W.; Howden, S. (National Radiological Protection Board, Harwell, Eng.). Health Phys.; 28: No. 1, 29-39 (Jan 1975).

The effect of chemical form on the tissue distribution and excretion of plutonium following its deposition in the respiratory system of the rat was studied. Solutions of various chemical forms of plutonium (nitrate, citrate, oxalate, dioxide, DTPA complex) were administered to rats by intubation into the nasopharyngeal, tracheobronchial, or pulmonary regions of the respiratory tract. The injection volume was less than 3 μl and the activity administered (2 to 3 nCi kg^{-1}) was comparable to a few maximum permissible body burdens of plutonium in man. The absorption of both plutonium nitrate and citrate from the pulmonary region was approximately four times greater than the absorption from either the tracheobronchial or nasopharyngeal regions. However, of the plutonium deposited in any of the three regions, the relative proportion that is translocated to other tissues is greater following administration as citrate than nitrate (approximately in the ratio of 1.6:1). The absorption of various chemical forms of plutonium from the pulmonary region was in general agreement with the conclusions of the ICRP Task Group on Lung Dynamics. About 13% of activity entering the blood during the first week after administration of plutonium nitrate or citrate was retained in the liver at 7 days implying that plutonium was circulating in the blood in a monomeric form. The cumulative excretion of plutonium in the urine in the same period was equivalent to about 4% of the total activity deposited in tissues from the blood. The experimental results suggest that this value could be used for calculating the total tissue deposit from urinary excretion measurements. (auth)

23082 LEAD-203 FOR SKELETAL IMAGING. Hoving, J.; Versluis, A.; Woldring, M. G. (Univ. Hospital, Groningen, Netherlands). J. Nucl. Med.; 16: No. 2, 170(Feb 1975).

Lead-203 has recently been proposed as a potential radionuclide for skeletal imaging. A whole-body image taken 3 days after intravenous injection of carrier-free ^{203}Pb-acetate in a rabbit suggested localization in skeleton as well as residual activity in liver and kidneys. This finding was confirmed using carrier-free ^{203}Pb-chloride, and a relatively low liver uptake of radioactivity in the adult rat was observed compared with the adult rabbit, suggesting a different body distribution of the radiopharmaceutical between the two species. (CH)

23083 IN VIVO UPTAKE OF Zn^{65} BY LIVER, KIDNEY AND SPLEEN FOLLOWING RADIATION CASTRATION. Sharma, S. C.; Gupta, G. S.; Dubey, D. P. (Panjab Univ., Chandigarh (India). Dept. of Biophysics). Strahlentherapie; 148: No. 2, 163-167 (Aug 1974).

3 figs.; 16 refs.

The distribution of ^{65}Zn in liver, spleen, kidney, and pancreas was studied after localized irradiation of testes at a single surface dose varying between 720 and 6,000 R. A sublethal dose of 720 R does not exhibit any remarkable change on the 15th day post irradiation, whereas 4,000 R seem to be an optimum dose for ^{65}Zn uptake by different organs. At 2,000 R, the maximum incorporation takes place on the 15th day. Liver and spleen are sensitive indices for alterations of testicular physiology. Testosterone propionate tends to lower the uptake of ^{65}Zn in radiation-castrated rats. FSH does not show any appreciable change in irradiated rats. It is suggested that the altered capacity for ^{65}Zn incorporation is due to hormonal imbalance produced locally or it may be related to the altered testis–pituitary axis due to radiation castration. (auth)

23084 BINDING OF CADMIUM AND MERCURY BY METALLOTHIONEIN IN THE KIDNEYS AND LIVER OF RATS FOLLOWING REPEATED ADMINISTRATION. Piotrowski, J. K.; Trojanowska, B.; Sapota, A. (Instytut Medycyny Pracy w Przemysle Wlokienniczym i Chemicznym, Lodz (Poland). Zaklad Biochemii). Arch. Toxikol.; 32: No. 4, 351-360(Sep 1974).

6 figs.; 1 tab.; 19 refs.

Rats were injected subcutaneously with either cadmium chloride labelled with ^{115m}Cd (0.5 mg Cd/kg) or mercuric chloride labelled with ^{203}Hg (0.5 and 0.25 mg Hg/kg) every other day over a period of 6 to 7 weeks. Levels of metals and metallothionein were determined in the liver and kidneys. Both cadmium and metallothionein accumulated in these organs during the period of exposure. Mercury and metallothionein accumulated only in the kidneys. Mercury did not accumulate in the liver, nor did it cause an increase of metallothionein in the liver. The molar ratio of 1.6 (metal to metallothionein) in liver was constant for cadmium. In the kidneys this ratio varied from 1 to 3 for both metals, depending on the level of the metal. This ratio was 0.1 for liver mercury. (auth)

23085 THE EFFECT OF STRONG CATIONITES (SULPHONE RESINS) ON THE RATE OF ^{137}Cs EXCRETION IN RAT. Majle, T.; Gorzkowski, B. (Panstwowy Zaklad Higieny, Warsaw (Poland)). Postepy Fiz. Med.; 8: 75-78(1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

The effects of Bio-Rex 40, Amberlite IR-120, and Dowex 50 × 4 in accelerating ^{137}Cs excretion in rats were compared. The effectiveness of resin intervention was also studied at longer delays of 6, 12, and 24 hours following contamination. (auth)

23086 ^{239}Pu INCORPORATION IN HAIR. Jaworoski, Z.; Bilkiewicz, J.; Zylicz, E. Postepy Fiz. Med.; 8: 173-178(1973). (In Polish).

^{239}Pu incorporation into growing hair in rabbits was compared with that in bones, liver, and muscles after a single subcutaneous administration of 0.1; 1.0 and 10.0 μCi per animal. In order to determine the effect of the time of contamination on ^{239}Pu incorporation into hair, the specimens were collected twice: 22 and 106 days after the isotope administration or on the day of destroying the animal. The average values of the ^{239}Pu incorporation into the first hair specimens (after 22 days) in terms of the fraction of the isotope dose per gm of the hair were higher for the 0.1 and 1.0 μCi doses than those for the 10.0 μCi dose. A similar dependence was found for the second series of specimens. In bones and livers the incorporation was higher by about two orders of magnitude than that in the growing hair, while in muscles it was at the same level. No effect of the dose on the extent of incorporation in the tissue was found. The lowest activity of ^{239}Pu uptake in the blood was calculated based on the analysis of the hair. (auth)

23087 PLUTONIUM–LYMPH RELATIONSHIP. Schallberger, J. A. Fort Collins, CO; Colorado State Univ. (1974). 181p. University Microfilms Order No. 75-4613.

Thesis (Ph. D.).

Uptake and transport mechanisms of soluble ($Pu(NO_3)_4$) and insoluble (polydispersed PuO_2) plutonium were studied in afferent and efferent lymph from the popliteal lymph nodes of dogs after simulated wound exposures. Normal values for constituents of canine lymph were determined. The validity of using electrophoretic techniques in studying the Pu-lymph relationship was evaluated. Lymph transport of monodispersed PuO_2 particles (0.16μ, 0.54μ, and 1.05μ) was compared. The normal lymph cell count was 220 cells/mm^3 in afferent lymph and 7398 cells/mm^3 in efferent lymph. Protein concentration in afferent lymph was 13.81 ± 4.02 mg/ml, while efferent lymph contained 21.43 ± 2.80 mg/ml. Discontinuous and isoelectric focusing gel electrophoretic systems were useful in determining which proteins bind Pu, but were inaccurate in determining percentages of Pu binding to specific proteins. Plutonium nitrate concentration was higher in the acellular fraction of both afferent and efferent lymph, while a greater concentration of PuO_2 was found in the cellular fraction. Particle size was not found to be a factor in the total movement (acellular and cellular lymph fractions) of Pu in afferent and efferent lymph. Regardless of particle size, more Pu moved in the cellular fraction of both afferent and efferent lymph than in the acellular fraction. Discontinuous gel, isoelectric focusing gel, and cellulose acetate strip electrophoresis indicated that transferrin and albumin were the two principal proteins transporting Pu in the acellular fraction of both afferent and efferent lymph. Immunoelectrophoresis proved to be an inaccurate technique to study the protein-bound plutonium. Fission track analysis indicated that dissolution of Pu particles was taking place at the wound site. Plutonium oxide particles at the implant site were larger than in afferent lymph and larger in afferent lymph than efferent lymph. (Diss. Abstr. Int., B)

Plants

23088 (N-74-26593) TOXICOLOGY: MECHANISMS OF DEUTERIUM OXIDE ACTION. Part II. Semiannual Report. Siegel, S. M. (Hawaii Univ., Honolulu (USA). Dept. of Botany). Dec 1973. 52p. (NASA-CR-138616). NTIS $5.75.

The metabolism of winter rye seedlings (Secale cereale, L cv. Winter) cultured in 99.6% D_2O was investigated. Compared with water grown seedlings, the protein content was much lower in the D_2O cultured seedlings and the incorporation of H(3)-leucine and H(3)-phenylalanine into medium to high molecular weight proteins was partially blocked. The synthesis of the enzyme peroxidase was also reduced in the D_2O plants. Seedlings cultured in D_2O incorporate H(3)-thymidine into DNA, but do not take up H(3)-uridine. These results suggest that some of the toxic effects of D_2O culture on higher plants can be attributed to a partial block of protein synthesis. (auth)

23089 (ORNL-tr-2907) ASSIMILABILITY OF Pu, Ru, AND Tc BY PHYTOPLANKTON. Gromov, V. V.; Spitsyn, V. I. Translated by M. Gerrard from Dokl. Akad. Nauk SSSR; 215: No. 1, 214-217(1974). 5p. Dep. NTIS $4.00.

Radioactive isotopes deposited in the ocean are, in time, converted to various physico-chemical forms which correspond to actual forms of their stable analogs in the ocean. The assimilability of these chemical elements by plankton is of considerable significance. The results are presented of studies on the absorption of ^{239}Pu, ^{106}Ru, and ^{99}Tc by cultures of unicellular green algae (Platymonas viridis) and natural colonies of phytoplankton taken from the surface along with seawater in the southeastern region of the Pacific Ocean (July 31, 1972, 9°18'1''S, 78°54'2''W). The experiments were carried out in the open air under natural conditions and also under conditions such that there was no photosynthesis, i.e., flasks with plankton in the liquid phase were kept in the dark. The temperature of the water was 20 to 28°C; the liquid phase volume was 0.8 liter. At definite time intervals, samples of water were taken from the flasks for radiometric measurements. This allowed monitoring of changes in the concentration of each isotope in the liquid phase. In individual cases, for monitoring purposes the radioactivity was determined in centrifuged or filtered plankton. (CH)

23090 INCORPORATION OF ^{32}P IN ORGANIC PHOSPHORUS COMPOUNDS OF BEAN SEEDLINGS AFTER DIFFERENT TERMS OF ANAEROBIOSIS. The Effect of Zn. Kolev, V. pp 567-575 of Vtora Natsionalna Konferentsiya po Botanika. Sofia; Bylgarska Akademiya na Naukite (1973). (In Bulgarian)

From 2nd national conference on botany; Sofia, Bulgaria (13 Oct 1969).

Experiments were carried out on 3-day germination of bean seeds in which the cotyledons were spared. The seeds were treated with zinc by 24-hr soaking in a 0.001 M solution. The plants absorbed 2.5 mCi of ^{32}P from Na_2HPO_4 solution in 4 hr. Phosphorus compounds were fractionated by the Kritskoi and Kulaev method, and the amounts were determined by the Weil, Molherbe, and Green method. The absolute amount of P compounds did not change in 44 hr of anaerobiosis, but the acid-soluble and free-nucleotide fractions changed markedly. The rate of P exchange, as indicated by the specific activity of the P compounds, decreased as the anaerobiosis time increased. Treatment with 0.001 M $ZnSO_4$ had a considerable effect on the rate of ^{32}P inclusion in the free nucleotides. It was concluded that the decreased oxygen content accelerated the energy process. (tr-auth)

23091 UPTAKE OF RADIOCESIUM FROM CONTAMINATED FLOODPLAIN SEDIMENTS BY HERBACEOUS PLANTS. Sharitz, R. R.; Scott, S. L.; Pinder, J. E.; Woods, S. K. (Savannah River Ecology Lab., Aiken, SC). Health Phys.; 28: No. 1, 23-28(Jan 1975).

Levels of radiocesium contamination in Sagittaria latifolia Willd. and Polygonum punctatum Ell., two herbaceous plant species sampled from Steel Creek on the AEC Savannah River Plant, are not correlated with total radiocesium concentrations in the soils on which they were growing. Soils showed a bimodal distribution of radiocesium contamination and were thus divided into low level and high level classes. With only one exception, plants from high and low level soils did not demonstrate significant differences in radiocesium contaminations. Concentration of radiocesium in leaves of Sagittaria latifolia was higher in plants growing on low level soils than on high level soils. Significant correlations were observed between radiocesium levels in component parts of the same plants; however, highest correlations occurred between similar components of near-neighbor plants

of the same species. Uptake of radiocesium by these two species appears to be related to factors other than the total soil concentration of the isotope. (auth)

Microorganisms

23092 UTILIZATION OF ACETATE-1-^{14}C IN THE SYNTHESIS OF LIPID BY ACHOLEPLASMAS. Herring, P. K. Columbus, OH; Ohio State Univ. (1974). 47p. University Microfilms Order No. 75-3092.

Thesis (Ph. D.).

Fifteen Acholeplasma strains incorporated radioactivity into their lipids when grown in media containing acetate-1-^{14}C. In most cases, a greater incorporation of acetate-1-^{14}C occurred when the acholeplasmas were grown in the medium with the lowest serum content. The majority of the radioactivity was found in the glycolipid (43%) and the polar lipid (53%) fractions. Radioactivity was also found in the neutral lipid fraction which contained some lipids that migrated as diglycerides when chromatographed. The amount of acetate-1-^{14}C radioactivity incorporated into the lipids (disintegrations per minute per milligram of lipid) of strains of six Mycoplasma species was less than 1% of the amount found in the fifteen Acholeplasma strains. At least 42% of the total lipid radioactivity was isolated in fatty acid methyl esters. All the acholeplasmas tested incorporated acetate-1-^{14}C into saturated fatty acids. This incorporation may result from de novo synthesis from acetate or elongation of pre-existing fatty acids. The acholeplasmas were grouped according to the percentage of recovered radioactivity isolated in the saturated fatty acid methyl ester fraction. The high group contains: A. laidlawii A (PG8), A. laidlawii B (PG9), A. laidlawii (Flamm), A. laidlawii (Granoff), A. laidlawii (Haig 179L), A. granularum (31B-1), A. granularum (BTS-39), A. oculi (A. oculusi) (19L), A. species (b3046), and A. species (Harris). The lower group contains: A. axanthum (S743), A. Axanthum (H86N), A. modicum (Squire, PG49), A. laidlawii (3M-152), and A. species (2310). Therefore, the ability to synthesize lipids or saturated fatty acids from acetate is another useful criterion for differentiating the genus Acholeplasma from Mycoplasma. (Diss. Abstr. Int., B)

New Tracer Techniques

Refer also to abstracts 21986, 22029, 22030, 22127, 22134, 22148, 22645, 22718, 22973, 23027, 23046, 23062, and 23082.

23093 (AD-787089) TECHNETIUM-99m DIPHOSPHONATE SCINTIGRAPHY TO DETECT EARLY AVASCULAR NECROSIS OF THE HIP. Stevenson, J. S.; Nelson, F. R.; McManaman, V. I. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Jul 1974. 13p. (AFRRI-TN-74-6). NTIS $3.25.

Ten National Naval Medical Center patients ages 20 to 62 and selected by history as having a high probability of early aseptic necrosis of the hip received bilateral tomographic hip technetium scans. The technetium-99m on a sodium diphosphonate carrier was injected between 2 and 3 hours prior to the scanning procedure. The gamma camera was centered over the hip, and tomographic cuts were made to approximately 500,000 counts each. The urinary bladder contained the greatest activity in most cases, which usually required the patient to void prior to the scan. Once the tomographic level of interest was ascertained, it was used identically for both hips. The data were then processed on a MED-II computer. Of the 10 studies, there were four true positives, four true negatives, and one each false negative and false positive. Although this series of patients is too small to draw any definite conclusions as to the accuracy of the method, it is apparent that it is a potentially effective means of detecting the presence of aseptic necrosis prior to radiographic changes. (auth)

23094 (CEA-CONF-2839) PROSPECTIVE PHARMACOLOGY OF RADIOPHARMACEUTICALS. Cohen, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 1974. 4p. (CONF-740926-6). Dep. NTIS (US Sales Only) $4.00.

From first world congress of nuclear medicine and exhibition meeting; Tokyo, Japan (30 Sep 1974).

By the mean of kinetics and from the nuclear data of the radionuclide one can calculate the absorbed dose in the organism and in the different organs. Some assumptions are made regarding the shape of the organs which are assimilated to simple geometrical figures as a sphere or a cylinder. A formula for use in calculations of the intrinsic γ absorbed dose rate is presented. The preclinical studies of a new radiopharmaceutical must include the chemistry and stability to radiolysis of the labelled chemical species, toxicity and adverse effects of the nonradioactive chemical species, kinetics of the radioactive chemical species and its by-products formed either by radiolysis or biotransformation, and radiation absorbed dose according to the radioactive dose administered to the patient whatever the route of administration is. If all these assays are satisfactory the radioactive drug may be proposed for clinical trial. (auth)

23095 QUALITATIVE AND QUANTITATIVE ANALYSIS OF RADIONUCLIDE CARDIOPULMONARY HISTOGRAMS. Rosenthall, L. (Montreal General Hospital). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 4, 479-493(Oct 1974).

The diagnostic value, inherent difficulties, and limitations of radionuclide scans for measurements of cardiac output lung perfusion, and assessing the presence of shunts are evaluated. (CH)

23096 STATIC DYNAMIC IMAGING OF THE BRAIN. Maynard, C. D.; Cowan, R. J. (Bowman Gray School of Medicine, Winston-Salem, NC). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 4, 447-477(Oct 1974).

Static and dynamic radionuclide imaging of the brain have come a long way during the past 10 years, and have a definite place in the work-up of neurological patients. Currently, the combination procedure is not capable of detecting all lesions that are present, and many times the information obtained from positive studies is nonspecific. The considerable success with the procedure, however, should not prevent us from continuing both basic and clinical research to improve the procedure through newer techniques, improved instrument design, and the development of additional helpful radiopharmaceuticals. (auth)

23097 TECHNIQUES OF NUCLEAR MEDICINE IN THE DIAGNOSIS OF TRAUMA. Tsai, S. H. (Hennepin County General Hospital, Minneapolis). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 4, 495-522(Oct 1974).

The value of radionuclide scans in the diagnosis of traumatic injuries of the head; cardiovascular injuries; and injuries to abdominal viscera, including rupture of the diaphragm, and injuries of the liver, spleen, and pancreas is evaluated and compared with radiographic techniques. (CH)

23098 RADIOLOGICAL AND RADIOISOTOPIC DIAGNOSIS OF PERIHEPATIC ABSCESS. Sanders, R. C. (Johns Hopkins Medical Institutions, Baltimore). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 2, 165-211(Apr 1974).

The radiological workup of a patient with clinical evidence suggestive of an abscess in or around the liver is a complex problem. A protocol is suggested for radiographic and radionuclide scintiscanning diagnostic techniques if symptomatology is vague. (CH)

23099 LIVER CIRCULATION. Viamonte, M. Jr.; Viamonte, M. (Univ. of Miami, FL). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 3, 351-387(Jun 1974).

Radionuclide scanning and radiographic techniques for the evaluation of pathological changes in blood flow in the liver are reviewed. (CH)

23100 DETECTION AND DIAGNOSIS OF RENAL MASSES WITH MODERN RADIOISOTOPE AND ULTRASONIC TECHNIQUES. Pritchard, J. H.; Winston, M. A. (Veterans Administration Wadsworth Hospital Center, Los Angeles). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 3, 423-445(Jun 1974).

The methodology, instrumentation, and accuracy of techniques used in nuclear medicine and ultrasonography for the detection and diagnosis of renal masses are reviewed. (CH)

23101 TECHNIQUES OF NUCLEAR MEDICINE FOR EVALUATION OF LUNG FUNCTION. Loken, M. K.; Ponto, R. A.; Goldberg, M. E. (Univ. of Minnesota Hospitals, Minneapolis). CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 3, 337-349(Jun 1974).

The diagnostic value of various radionuclide techniques for the measurement of lung ventilation and perfusion parameters is discussed critically. (CH)

23102 SCINTIGRAPHY OF BREAST MASSES. Raskin, M. M.; Zand, L. C.; Serafini, A. N. (Mount Sinai Medical Center, Miami Beach, FL). Radiology; 114: No. 2, 465-467(Feb 1975).

From 59th scientific assembly of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Patients undergoing bone scintigraphy or about to have breast surgery were studied with either ^{99m}Tc-polyphosphate or ^{99m}Tc-diphosphonate. Seven of 8 patients with carcinoma demonstrated a focal area of increased uptake. The 9 controls, who were clinically free of breast disease, had normal images. In the benign group, increased uptake was seen in patients with gynecomastia, lactating breasts, or acute inflammation. Most patients showed correlation with mammography and thermography. (auth)

23103 EFFECT OF FOCAL SPOT DISTRIBUTION ON BLOOD VESSEL IMAGING IN MAGNIFICATION RADIOGRAPHY. Doi, K.; Rossmann, K. (Univ. of Chicago). Radiology; 114: No. 2, 435-441(Feb 1975).

From a computer simulation study of blood vessel imaging with uniform, triangular, gaussian, and twin gaussian line spread functions (LSF) corresponding to various focal spot distributions, it is found that vessel images magnified less than 6× are not strongly dependent upon the focal spot distributions when the size of the focal spot is equal to or smaller than the vessel diameter. When the focal spot is larger than the vessel, image distributions vary appreciably with focal spot distributions, except at low magnification. It is concluded that, in many practical cases, the focal spot distribution does not seriously affect magnified image distributions of blood vessels. (auth)

23104 EARLY CLINICAL EXPERIENCE WITH THE ACTA SCANNER. Schellinger, D.; Di Chiro, G.; Axelbaum, S. P.; Twigg, H. L.; Ledley, R. S. (Georgetown Univ. Medical Center, Washington, DC). Radiology; 114: No. 2, 257-261(Feb 1975).

From 60th scientific assembly of the Radiological Society of North America; Chicago, IL (1 Dec 1974).

An alternative method of computed tomography was devised employing the ACTA scanner. This is a total-body scanner, which permits study of virtually all body parts, since a water medium is not employed. Early clinical experience with this method is discussed, and normal and pathological scans are presented. (auth)

23105 SPLENIC MOBILITY AND ITS EFFECT ON ESTIMATES OF SPLENIC MASS. Chiles, J. T.; Mintzer, R. A.; Hoffer, P. B.; Gottschalk, A. (Univ. of Chicago). Radiology; 114: No. 2, 407-410(Feb 1975).

In 47 patients the posterior radionuclide views of the spleen in supine and prone positions were evaluated for difference in splenic contour and calculated splenic weight as the patient's position was changed from supine to prone. A significant change in splenic contour was found in almost 50% of the cases. Values for the mass of the spleen varied by a mean of 36% with a range of +195 to −79%. The differences are attributed primarily to changes in the position of the spleen and liver within the abdomen. (auth)

23106 BIFURCATION OF THE PORTAL VEIN APPEARING AS A FOCAL DEFECT ON THE LIVER IMAGE. Shanser, J. D.; Korobkin, M.; Hattner, R. S.; Palubinskas, A. J. (Univ. of California, San Francisco). Radiology; 114: No. 2, 399-401 (Feb 1975).

A focal defect was seen on a gamma camera image of the liver in 2 patients, a 52-year-old woman with abdominal pain and a 46-year-old woman with pancytopenia. Liver function was normal, and no tumor stain was seen. Angiography revealed that the defect was in reality the bifurcation of the portal vein. These findings re-emphasize the importance of visceral angiography as a complement to radionuclide imaging in the study of liver disease. (auth)

23107 SEQUENTIAL BRAIN SCANNING AS AN ADJUNCTIVE SCANNING PROCEDURE. Christie, J. H.; Go, R. T.; Suzuki, Y.; Tonami, N.; Schapiro, R. L. (Univ. of Iowa, Iowa City). Radiology; 114: No. 2, 381-387(Feb 1975).

Sequential brain scans were performed at various time intervals of up to four hours after injection of ^{99m}Tc pertechnetate in 108 patients who had previously undergone routine one-hour brain scans which were considered normal or equivocal. Forty-six patients were proved to have a discrete morphologic brain lesion. Pathologic processes were demonstrated by the sequential scanning technique in all but 6 cases. In nearly a third of these 46 patients (28%), careful observation of the progressive and subtle changes in radioactivity in the whole sequential scan series was necessary for detection of the lesions: they could not be appreciated on any single static scan when viewed independently. (auth)

23108 DYNAMIC SCINTIGRAPHY OF PRIMARY AND SECONDARY MALIGNANT INTRACRANIAL NEOPLASMS. Sheldon, J. J.; Smoak, W. M.; Serafini, A. N.; Raskin, M. M. (Univ. of Miami, FL). Radiology; 114: No. 2, 373-380(Feb 1975).

From 59th scientific assembly of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Dynamic images and arteriograms were reviewed in patients with proved primary and secondary malignant intracranial neoplasms. In 44% of the patients with glioblastomas and 23% of those with metastatic lesions, radioactivity appeared early in the dynamic imaging sequence. This was related to the presence of arteriovenous shunting on arteriography rather than to a tumor stain. Neither characteristic dynamic imaging patterns nor rapid arteriovenous shunting was seen in patients with astrocytomas. (auth)

23109 DURAL FLUID COLLECTIONS IN INFANTS AND CHILDREN. A Successful Nuclear Medical Approach. Gilday, D. L.; Ash, J.; Milne, N. (Hospital for Sick Children, Toronto). Radiology; 114: No. 2, 367-372(Feb 1975).

From 59th scientific assembly of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Experience in 94 cases of dural fluid collections is described. The correct diagnosis was made in 94%, which is attributed to including radionuclide angiography and both an immediate and a two- to four-hour delayed scan for every patient undergoing brain studies, a high index of suspicion, and simultaneous interpretation of the scan and the skull film. The false-positive rate was 10%, as shown by cerebral angiography. (auth)

23110 BONE SCANNING IN EVALUATION OF PAGET'S DISEASE OF BONE. Shirazi, P. H. (Lutheran General Hospital, Park Ridge, IL); Ryan, W. G.; Fordham, E. W. CRC Crit. Rev. Clin. Radiol. Nucl. Med.; 5: No. 4, 523-558(Oct 1974).

Radionuclide imaging of the skeletal system offers an economical and sensitive means for evaluating bony disorders. It is extremely useful in the workup of pain and elevated serum alkaline phosphatase levels and in identifying and evaluating the extent of suspected and unsuspected Paget's disease. It is useful in following patients treated for symptomatic Paget's disease in evaluating progression, remission, and/or recurrence where the scan findings correlate well with the information gained by other modalities. The incidence, anatomic distribution, complications, characteristic appearance, and differential diagnosis of Paget's disease are discussed. (auth)

23111 EFFECTS OF ORAL ADMINISTRATION OF CHLORHEXIDINE ON THE RATE OF REGENERATION OF EPITHELIA OF THE ORAL MUCOSA AND SKIN OF MICE. Mackenzie, I. C. (Univ. of Iowa, Iowa City). J. Periodontal Res.; 9: 181-197(1974).

Using injection of tritiated thymidine and autoradiography, the labelling index, rate of migration of labelled cells and width of epithelia of the oral mucosa and skin of mice was examined after either (a) 2% chlorhexidine solution or (b) distilled water, was instilled twice daily for 7 days into the oral cavity. A small but consistent reduction in the rate of regeneration of epithelia in chlorhexidine-treated animals was attributed to the added stress to which the experimental group was exposed. It was anticipated that a direct irritant effect of chlorhexidine on the oral mucosa would produce a locally increased rate of epithelial regeneration: no such change was observed. No change in the labelling index of the liver or in the rate of gain of weight in experimental animals was detected during the experimental period. (DG)

23112 SELENIUM CARRIER PROTEINS IN MOUSE PLASMA. Sandholm, M. (Coll. of Veterinary Medicine, Helsinki). Acta Pharm. Toxicol.; 35: 424-428(1974).

The selenium carrier proteins in mouse plasma were studied using ^{75}Se-selenite and a crossed immunoelectrophoresis-autoradiography. The selenite was not bound to plasma proteins in vitro unless erythrocytes were present. Intravenously administered selenite was attached to the same proteins as the selenite-Se metabolized by the erythrocytes in vitro. (DG)

23113 QUANTITATIVE COMPARISON OF ^{99m}Tc–IRON HYDROXIDE AGGREGATES AND ^{133}Xe PULMONARY PERFUSION, AND IMPORTANCE OF SENSITIVITY-CORRECTED GAMMA-CAMERA DATA. Brookeman, V. A. (Veterans Administration Hospital, Gainesville). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 425-532(Oct 1974).

Unilateral and four-quadrant regional pulmonary perfusion fractions were quantitatively compared for ^{99m}Tc-iron hydroxide aggregates and superior-vena-cavally administered ^{133}Xe in 23 patients with chronic obstructive lung disease and a coin lesion, using a γ camera/PDP-8/1 system. ^{99m}Tc and ^{133}Xe perfusion fractions were equivalent (±0.03), with correlation coefficient ≥ 0.9. Unilateral ^{99m}Tc perfusion fractions, measured only with the camera operated in divided mode, were insignificantly different from computer-processed ^{133}Xe fractions. Correction of camera data for non-uniform sensitivity response was not necessary for determination of unilateral or four-quadrant perfusion fractions, but may be important in determining absolute ^{133}Xe clearance half-times. Simple static ^{99m}Tc-iron hydroxide aggregates imaging was as accurate as dynamic ^{133}Xe studies for routine clinical estimation of unilateral or four-quadrant pulmonary perfusion. (auth)

23114 PHYSICOCHEMICAL STUDY OF THE ELECTROLYTIC INCORPORATION OF IODINE INTO BOVINE GROWTH HORMONE (BGH). Caro, R. A.; Ciscato, V. A.; De Giacomini, S. M. V.;

Kurchart, H.; Quiroga, S.; Radicella, R. (Buenos Aires Univ. Nacional). Int. J. Appl. Radiat. Isotop.; 25: No. 11/12, 497-500 (Dec 1974).

The mechanism of iodination of the Bovine Growth Hormone (BGH) by means of the electrolytic method (at pH 7.4) was studied as a function of time and of total iodide to protein ratios. The yield of each labelling process was determined by paper electrophoresis. From these values and the respective iodide to protein molar ratios, the iodination degrees were calculated; frequently, iodination degrees higher than 12 (the maximum theoretically possible), were obtained. When the enzymatic hydrolysis of the samples was carried out, an increase of free iodide was observed, which was more significant at high iodide to protein molar ratios. The quantitative analysis of the chromatograms of the hydrolysates, allowed determination of the relative amount of monoiodinated tyrosine residues (MIT) and diiodinated tyrosine residues (DIT) for different iodination degrees. It could be shown that for iodination degree of 12, only 70% of the radioactivity appeared as DIT. The calculation of the relative iodination degree for each molar ratio of iodide to protein, demonstrated that only 75% of the total available sites at the tyrosine residues admits the incorporation of iodine. Thus, it can be deduced that not all the tyrosine residues are equally accessible for the iodine atom. (auth)

23115 RADIO-ENZYMIC ASSAY OF OXO STEROIDS BY THEIR REDUCTION WITH THE TRITIATED FORM OF REDUCED NICOTINAMIDE-ADENINE DINUCLEOTIDE. Norymberski, J. K.; Stoddart, N.; Wolstenholme, J. B. (Univ. of Sheffield, Eng.). Biochem. J.; 145: No. 1, 47-51(Jan 1975).

A method of analysis is proposed based on the enzyme-catalyzed transfer of tritium from [^{3}H]NADH to suitable substrates. Its practicability was demonstrated on the examples of estrone and progesterone with the respective use of the 3β, 17β- and 3α, 20β-hydroxysteriod oxidoreductase. Specificity was tested by application to the analysis of the plasma of pregnant women and measurement of the ^{3}H/^{14}C ratios on purification of the enzymic reduction products. (auth)

23116 DETERMINATION OF RED CELL SURVIVAL BY ACTIVATION ANALYSIS. Uchiyama, G.; Akiba, H.; Kakehi, H. (Chiba Univ., Japan). Int. J. Nucl. Med. Biol.; 2: No. 1, 37-40 (Jan 1975).

The determination of red cell survival by activation analysis using non-radioactive enriched ^{50}Cr was clinically applied. The method described is very practical with the use of a lithium-drifted germanium detector which avoids chemical separation of samples after neutron irradiation. Though there were scatterings in individual data points of ^{50}Cr, fairly good agreements were obtained between half-lives of ^{50}Cr labelled red cells and those of ^{51}Cr labelled red cells. (auth)

23117 MOPPING: A MECHANISM OF BINDING LABELLED COLLOID TO ALBUMIN MACROAGGREGATES FOR PERFUSION LUNG SCANNING. Thomas, J.; Wiener, S. N. (Mount Sinai Hospital, Cleveland). Int. J. Appl. Radiat. Isotop.; 25: No. 10, 463-467(Oct 1974).

The production of several lung imaging agents involves radionuclide labeling of colloid and the subsequent binding of colloid to albumin macroaggregates. As the macroaggregate is broken down, the labeled colloid remains intact to be phagocytized by the reticulo-endothelial cells of the liver. Proof of the radionuclide-colloid to macroaggregate linkage can be shown by identifying the distribution and biologic fate of several lung perfusion radiopharmaceuticals at each step during their preparation. (auth)

23118 SHORT-TERM RADIORESPIROMETRY OF CELL SUSPENSIONS. Duncombe, W. G. (Wellcome Research Labs., Beckenham, Eng.). Biochem. J.; 144: No. 3, 487-496(Dec 1974).

An apparatus and method are described with which the oxidation of labelled substrates to $^{14}CO_2$ by cell suspensions may be examined. The use of high-specific-radioactivity substrates at low concentration together with frequent quantitative collection of CO_2 permitted more detailed analysis of the appearance of various substrate carbon atoms as CO_2 than was possible by existing techniques. Typical experiments with various cell types are reported in which pathways of glucose oxidation were examined. (auth)

23119 IMMUNOCHEMISTRY OF NEUROPITUITARY HORMONES. Vaneckova, J. (Inst. of Organic Chemistry and Biochemistry, Prague). Chem. Listy; 69: No. 1, 70-83(1975). (In Czech).

A review is presented of the current knowledge of the problematics of immunochemistry of neuropituitary hormones, oxytocin and vasopressin. Data are given on the preparation of antigenic forms of peptidic hormones, the results of immunization of animals with single antigens, and the methods of determination of antibodies. Radioimmunological determinations of oxytocin, vasopressin, and the specificity of the antibodies obtained are given in detail. (auth)

23120 PROBENECID AND HEPATIC TRANSPORT OF ^{3}H-OUABAIN IN RATS. Erttmann, R.; Samm, K. H. (Univ., Hamburg). Arch. Int. Pharmacodyn.; 211: No. 2, 197-210(1974).

In vivo studies on the distribution and biliary excretion of ^{3}H-ouabain (40 μg/kg) in rats gave evidence that probenecid (200 mg/kg) inhibited the liver uptake of the glycoside without affecting its biliary excretion; glycoside contents in liver and kidney decreased to 50% and 60%, respectively, whereas levels in plasma and muscle increased 1.5- and 2.5-fold, respectively, 90-min experiments compared with controls. The increase in the biliary excretion rate of ^{3}H-ouabain from 42% to 47% was not significant. The accumulation of ^{3}H-ouabain in rat liver slices reached T/M ratios of 3.3 after 90 min and 5.5 after 180 min. Equilibrium was not yet reached after this time. No saturation in uptake was observed within a range from 2×10^{-9} to 2×10^{-5} M ouabain concentration, but a dependence on temperature, oxygen supply, and on intact y-protein (ligandin) was obvious. The decrease of ouabain uptake by probenecid (0.175-10.5mM) was dose dependent, but this was hardly due to a competitive mechanism. Also the inhibitory effects of digitoxin were most likely to be non-competitive. Bromcresol green (2×10^{-2} M) and basic cyanine dye (4×10^{-3} M) did not influence the uptake of ^{3}H-ouabain. It is concluded that ouabain uptake in liver is mediated by an energy dependent process which is different from the mechanism of its biliary excretion. The influence of probenecid on the liver uptake of ouabain is interpreted as secondary inhibition. (auth)

23121 EVALUATION OF A COMPUTERIZED TECHNIQUE FOR DETERMINATION OF CARDIAC OUTPUT AND CENTRAL CIRCULATION TIMES USING GAMMA CAMERA AND ^{113m}In. Falch, D.; Norman, N. (Aker Sykehus, Oslo). Scand. J. Clin. Lab. Invest.; 34: No. 3, 207-214(Nov 1974).

A method for quantitative radiocardiography using a gamma camera, multichannel analyzer, computer, and magnetic tape recorder is presented and evaluated. (^{113m}In)transferrin (a pure gamma emitter with an energy of 392 KeV, half-life of 99.5 min) was used as the intravascular tracer. This has some advantages over ^{131}I-human serum albumin and ^{99}Tc-human serum albumin. The cardiac output was determined simultaneously by radiocardiography and an oridinary indicator dilution technique based on continuous sampling of arterial blood. The coefficient of correlation between the results of the two methods was 0.96. The mean pulmonary circulation time could be selectively determined. It was 4.90 sec (S. D. 0.84) in 14 healthy subjects, which represented 75.8 per cent of the interventricular circulation time. The mean pulmonary blood volume in the 14 subjects was 297 ml/m^2(S. D. 38) and the mean pulmonary plasma volume 179 ml/m^2 (S. D. 21), or 11.1 per cent (S. D. 1.7) of the total plasma volume. The method is rapidly performed without stress for the patient, can be repeated at frequent intervals, and gives reliable information about cardiac function and pulmonary circulation. (auth)

23122 ABNORMAL BRAIN SCANS IN ADRENAL LEUKODYSTROPHY. A Study of Three Cases. Higgins, C. B.; Taketa, R. M.; Halpern, S. E. (Univ. of California, San Diego, La Jolla). Radiology; 114: No. 3, 667-669(Mar 1975).

Brain scintiphotography ($^{99m}TcO_4$) in three patients with the clinical characteristics of adrenal leukodystrophy demonstrated focal areas of increased uptake of the radionuclide. Histological examination of cerebral tissue corresponding to the abnormal foci on the scan revealed subanophillic leukodystrophy. These findings suggest that areas of active demyelination, such as occur in adrenal leukodystrophy, accumulate radionuclide. Thus, brain scintiphotography may be useful in the evaluation of patients in whom the diagnosis of adrenal leukodystrophy is being considered. (auth)

23123 VASCULARITY OF THE FEMORAL HEAD: ^{18}F SCINTIGRAPHY VALIDATED WITH TETRACYCLINE LABELING. Stadalnik, R. C.; Riggins, R. L.; D'Ambrosia, R.; DeNardo, G. L. (Univ. of California, Davis). Radiology; 114: No. 3, 663-666(Mar 1975).

Blood flow to the femoral head was assessed by ^{18}F positron scintigraphy and tetracycline fluorescent labeling in 17 patients undergoing replacement of the femoral head with an endoprosthesis. Radioactivity was absent in the femoral head of 10 patients, normal in 5, and increased in 2. Normal or increased radioactivity indicated presence of blood flow to the femoral head; decreased or absent radioactivity indicated absence of blood flow. Results of ^{18}F scintigraphy correlated with those of tetracycline labeling. (auth)

23124 PATTERNS OF EXCRETION OF RADIOACTIVE CHELATES IN OBSTRUCTIVE UROPATHY. Kirchner, P. T.;

James, A. E. Jr.; Reba, R. C.; Wagner, H. N. Jr. (Johns Hopkins Univ., Baltimore). Radiology; 114: No. 3, 655-661(Mar 1975).

Radioactive chelates such as ^{99m}Tc-DTPA are advantageous in renal imaging, particularly in defining functional and morphological abnormalities of the excretory tract. In a review of more than 100 studies, 19 cases of lower-tract disease were diagnosed by the gamma camera image along. In 16 of them, the diagnosis was confirmed by excretory urography. Normal radionuclide patterns are described and compared with the characteristic findings in caliectasis, hydronephrosis, and hydroureter. By facilitating evaluation of renal perfusion, renal glomerular function, and gross renal structure as well as good definition of excretory function, radioactive chelate imaging is ideally suited for use as a general screening test. (auth)

23125 TEMPORAL AND PATHOLOGICAL SIGNIFICANCE OF PERFUSION FAILURE FOLLOWING RENAL TRANSPLANTATION. Freedman, G. S.; Schiff, M.; Zager, P.; Jones, D.; Hausman, M. (Yale Univ., New Haven). Radiology; 114: No. 3, 649-654(Mar 1975).

Serial dynamic studies with ^{99m}Tc-DTPA are a useful method of monitoring renal transplants. Radionuclide images obtained within 24 hours after surgery and at regular intervals thereafter can identify pathological conditions. The decline or absence of perfusion, coupled with the elapsed time following surgery, can be used to differentiate vascular occlusion or hyperacute rejection from acute rejection, acute tubular necrosis, or accelerated or chronic rejection. ^{99m}Tc-pyrophosphate can be used to simultaneously evaluate transplant function and locate possible aseptic necrosis of bone. Both studies are noninvasive and have been performed safely on numerous occasions over a period of several years. (auth)

23126 RADIORECEPTOR ASSAY FOR HUMAN CHORIONIC GONADOTROPIN. Lee, C. Y.; Ryan, R. J. (Mayo Clinic, Rochester, MN). J. Clin. Endocrinol. Metab.; 40: No. 2, 228-233 (Feb 1975).

A sensitive radioreceptor assay capable of detecting 100 pg of human chorionic gonadotropin has been developed using ovarian receptor and [^{125}I]hCG. The dose-response curves of a series of urine and serum samples from pregnant women were linear and parallel to standards curve of 2nd International Standard hCG and purified hCG when logit of percent bound was plotted against log dose. Potency estimates of pregnancy sera, measured by radioreceptor assays, were approximately 2 times greater than those determined by radioimmunoassays. Examination of hCG concentrations in the urine of pregnant and nonpregnant women, using a receptor assay, showed good correlation with the result obtained with a standard agglutination pregnancy test. This radioreceptor assay, which can be made as sensitive as radioimmunoassay, provides a rapid and simple method for the measurement of biologically active hCG and LH. (auth)

23127 SINGLE DOSE METYRAPONE TEST: 11β-HYDROXYLASE INHIBITION BY METYRAPONE AND REDUCED METYRAPONE ASSAYED BY RADIOIMMUNOASSAY. Meikle, A. W.; West, S. C.; Weed, J. A.; Tyler, F. H. (Univ. of Utah, Salt Lake City). J. Clin. Endocrinol. Metab.; 40: No. 2, 290-295(Feb 1975).

To assess the effects of metyrapone and reduced metyrapone on 11β-hydroxylase inhibition, the plasma levels of cortisol, 11-deoxycortisol, and the inhibitors were measured by radioimmunoassays in 34 normal subjects 8 h after they received a single oral dose of metyrapone at midnight. The ratio of 11-deoxycortisol to cortisol, as an index of 11β-hydroxylase inhibition, was compared to plasma levels of metyrapone and reduced metyrapone. One subject received an infusion of metyrapone ditartrate in order to study the sequential conversion of metyrapone to reduced metyrapone. A new radioimmunoassay was developed for measurement of plasma concentrations of metyrapone and reduced metyrapone. Following intravenous administration of metyrapone, it is rapidly converted to an active metabolite, reduced metyrapone. At 8 h after a dose was given, the average reduced metyrapone level was 1.5 times higher than the average metyrapone level. Following oral administration of the drug, we found a high correlation when plasma levels of metyrapone were compared to reduced metyrapone and when the ratio of 11-deoxycortisol to cortisol was related to metyrapone or to total metyrapone levels. In conclusion, the conversion of metyrapone to reduced metyrapone is such that by 8 hours after a single oral dose, more than one-half of the inhibitory effect on 11β-hydroxylase appears to be produced by reduced metyrapone. The inhibitory action of metyrapone and reduced metyrapone on the enzyme system is reflected by their concentration in plasma. (auth)

23128 MELATONIN RADIOIMMUNOASSAY. Arendt, J.; Paunier, L.; Sizonenko, P. C. (Univ., Geneva). J. Clin. Endocrinol. Metab.; 40: No. 2, 347-350(Feb 1975).

A radioimmunoassay for melatonin has been developed after the raising of anti-melatonin antibodies in rabbits. The radioimmunoassay is specific and the sensitivity range is greater than the tadpole bioassay. (auth)

23129 OXYGEN CLOCK: A DUAL TRACER PHYSIOLOGICAL TIMER. Nickles, R. J.; Au, Y. F. (Univ. of Wisconsin, Madison). Phys. Med. Biol.; 20: No. 1, 54-66(Jan 1975).

In vivo differential decay of the radioisotopic pair ^{19}O/^{15}O was used to measure the regional label "age". Simplified expressions were developed relating the measured age to oxygen transit times and utilization. Simultaneous production of the label pair employed a continuous flow, mixed-gas target irradiated by the University of Wisconsin tandem Van de Graaff accelerator. Flow-through chemistry followed, with transport to the user site up to several hundred metres distant. Gamma energy spectra from a twelve-probe detector array were recorded in an on-line computer during prolonged normal breathing of doubly labelled air. While the dynamics of oxygen compounds are of great physiological importance, the lack of compartment specificity of the ^{19}O/^{15}O pair raised fundamental questions in the interpretation of the age results. (auth)

23130 KINETIC STUDY OF THE DISSOLUTION OF THALLIUM AMALGAM BY A RADIOACTIVE TRACER METHOD. Madi, I.; Bolyos, A. (Kossuth Lajos Univ., Debrecen, Hungary). Radiochem. Radioanal. Lett.; 20: No. 3, 215-219(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

The kinetics of dissolution of a weak thallium amalgam, labelled with ^{204}Tl, was studied in contact with sulfuric acid solution containing p-nitrophenol of various concentrations. The numerical values of the rate constants of the dissolution were determined, and from their temperature coefficients the activation energy of the dissolution process was also obtained. The results were interpreted on the basis of the Wagner theory of the additivity of partial electrochemical processes. (auth)

23131 RADIOMETRIC ASSAY OF PROTEOLYSIS BY CRUDE PLANT EXTRACTS. Haissig, B. E.; Schipper, A. L. (USDA Forest Service, St. Paul, MN). Biochem. Biophys. Res. Commun.; 63: No. 1, 57-61(3 Mar 1975).

Hydrolysis of bovine serum albumin and [^{125}I]bovine serum albumin by crude plant extracts was measured by the Lowry method and liquid scintillation spectrometry. Measurement of protein hydrolysis by [^{125}I] is faster, more sensitive, and more specific than by the Lowry and probably other colorimetric methods. In addition, the [^{125}I] method can measure hydrolysis by crude extracts of endogenous plant proteins. (auth)

23132 HORMONAL CONTROL OF THE EQUINE REPRODUCTIVE CYCLE: TEMPORAL RELATIONSHIP OF LUTEINIZING HORMONE AND ESTRADIOL AS STUDIED BY RADIOIMMUNOASSAY. Pattison, M. L. Manhattan, KS; Kansas State Univ. (1974). 71p. University Microfilms Order No. 75-2531. Thesis (Ph. D.).

Present studies describe the development of a highly specific and sensitive radioimmunoassay for equine LH and estradiol-17B (E_2). Reliable estimates of LH could be determined in 75-150 ul of serum and components of serum did not appear to influence the LH assay. Nine large mares and 15 pony mares were used to describe the temporal relationships of LH and E_2. Serum LH and E_2 were measured during 8 estrous cycles and rectal palpations performed to determine the day of ovulation. Serum LH increased gradually from a diestrus low of 20.0 ± 0.4 ng/ml approximately 5 days prior to ovulation to a peak of 129.34 ± 7.1 ng/ml the day of ovulation. Serum E_2 increased from 20.0 ± 0.2 pg/ml to a peak of 141.00 ± 9.8 pg/ml 2 days before LH peaked. Intramuscular injection of E_2 or estradiol benzoate to anestrous or ovariectomized pony mares was followed 4 hours later by a rapid increase in serum estrogen and a surge of LH secretion. The latent period of the estrogen stimulus for LH surge was approximately 12 hours and the dose required was 2 to 4 mg. The LH surge was maintained for approximately 10 hours. Progesterone alone (4 mg) or in combination with estrogen (10 mg progesterone plus 4 mg benzoate) did not increase serum LH levels for 36 hours after injection. Pituitary responsiveness to synthetic LH-releasing hormone (LH−RH) was greatest during estrus than any other time of the cycle. Treatment with LH−RH during diestrus (5-70 ug) did not significantly increase serum LH above 25 ng/ml whereas treatment during estrus (10 ug) increased serum LH 40 times above the preinjection levels within 10 to 20 minutes post injection. Estrogen was found to augment the effect of synthetic LH−RH in anestrous pony mares. Twenty ug of LH−RH administered intravenously to an anovulatory cycling mare on the 4th day of estrus induced a rapid increase in serum LH within 20 minutes and ovulation within 24 hours.

It is likely that estrogen is a major factor in the mechanism of LH release. (Diss. Abstr. Int., B)

23133 MAPPING OF FUNCTIONAL NEURAL PATHWAYS BY AUTORADIOGRAPHIC SURVEY OF LOCAL METABOLIC RATE WITH [^{14}C]DEOXYGLUCOSE. Kennedy, C. (National Inst. of Mental Health, Bethesda, MD); Des Rosiers, M. H.; Jehle, J. W.; Reivich, M.; Sharpe, F.; Sokoloff, L. Science; 187: No. 4179, 850-853(7 Mar 1975).

If sufficient time has elapsed following an intravenous pulse of [^{14}C]deoxyglucose, the carbon-14 contents of the tissues of the central nervous system represent mainly the accumulated phosphorylated derivative of [^{14}C]deoxyglucose and reflect the rates of glucose consumption of the tissues. Altered functional activity alters metabolic activity and the uptake of [^{14}C]deoxyglucose in the tissues. By autoradiographic survey of sections of the central nervous system it is then possible to map all the regions with altered functional and metabolic activities in response to experimentally induced changes in functional state. (auth)

23134 COMPUTER-ASSISTED THYROIDAL TECHNETIUM UPTAKE MEASUREMENT USING A SHORT PINHOLE-TO-SURFACE DISTANCE. Armstrong, D. I.; Rogers, T. G. H.; Brownlie, B. E. W. (Christchurch Hospital, New Zealand). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 60-66(Jan 1975).

The close pinhole view of the thyroid presents some important measurement problems. Possible errors due to gland, neck and set-up geometry are accentuated due to the effects of the inverse square law, and care is needed to control these. The nonuniform response inherent in the use of the pinhole collimator has a significant effect, but with computer processing this is readily eliminated. ENR subtraction may become difficult in certain circumstances, as insufficient "background areas" may be viewed, but it has been shown that the use of a "universal" (for the particular system) ENR subtraction may give, if anything, more accurate results. With these precautions in use, important errors will be of the same order of magnitude as those involved in more distant views, and may thus be kept within the realms of clinical significance. On the other hand, considerable improvements in both resolution and sensitivity make the use of the closer view an asset to both the research laboratory and the small department involved mainly in routine service work. (auth)

23135 DETECTING MALIGNANT CELLS. Cobb, C. M. (to American Science and Engineering, Inc.). US Patent 8,357,033. 24 Dec 1974. Filed data 26 Apr 1972. 22p.

Techniques for detecting malignant cells, especially useful in Papanicolau smear analysis, comprise placing the scrapings of epithelial cells from the cervix or oral cavity, obtained either as fresh samples or samples previously fixed in alcohol, formalin, Bouin's solution, or other standard fixatives (provided that fixatives which may react with the gallium be removed from the cells by washing prior to use) in a solution containing gallium chloride, gallium citrate or another gallium salt and allowing the gallium to be absorbed by the cells. After an equilibration period of 20 minutes to 24 hours, so that gallium pickup by malignant cells is complete, excess gallium is removed by repeated washing of the cellular material. According to one aspect of the invention, the treated cells are used to prepare a smear on a slide which may be stained. The total number of cells present, or the mass of the smear is determined by a separate measurement, such as weighing. The gallium present may then be determined by radioactive counting techniques or by fluorescent techniques. These techniques may embrace one or both of integrated measurement or point-by-point scanning. According to another aspect of the invention, the treated cells may be examined one by one for gallium content in a capillary flow apparatus using either the nuclear radiation of a gallium isotope to detect the gallium present in the individual cells or the treated cells may be subjected to a secondary treatment with a dye such as 8-hydroxyquinoline which has a high specific fluorescence when combined with gallium and the gallium content of individual cells determined by a fluorescent detection method. (Official Gazette)

23136 DETECTION OF BIOLOGICAL ACTIVITY. Waters, J. R. US Patent 3,858,045. 31 Dec 1974. Filed date 24 Apr 1973. 6p.

A sample of blood to be tested for the presence of biological activity is added to a suitable growth medium which includes a ^{14}C containing carbon source fermentable to produce gaseous $^{14}CO_2$. After a suitable incubation period, a portion of the gaseous atmosphere above the medium is analyzed for the presence of radioactivity. In the improvement herein described, mammalian cells in the blood sample are lysed in order to reduce background reading when the radioactivity is measured and to provide a better signal-to-noise ratio. (Official Gazette)

23137 GROUP EXPERIMENTS ON THE RADIOIMMUNOLOGICAL INSULIN DETERMINATION. Maier, V. (Ulm Univ. (F. R. Germany). Sonderforschungsbereich Endokrinologie); Marschner, I.; Scriba, P. C. (Muenchen Univ. (F. R. Germany). 2. Medizinische Klinik); Bottermann, P. (Technische Univ. Muenchen (F. R. Germany). 2. Medizinische Klinik und Poliklinik); Schwandt, P. (Muenchen Univ. (F. R. Germany). 1. Medizinische Klinik); Erhardt, F.; Loeffler, G.; Vogt, W.; Linke, R. Horm. Metab. Res.; 6: No. 4, 293-296(Jul 1974).

3 figs.; 1 tab.; 4 refs.

By means of two group experiments, performed in seven laboratories and using six different modifications in the insulin radioimmunoassay technique, it is shown that the use of standards diluted in human serum of low basal insulin concentration, instead of buffer, improves appreciably the interlaboratory precision. The cause lies perhaps in some serum factor, which could disturb some modifications of the radioimmunoassay more than others. There was no improvement of precision when the same insulin standard was used in all laboratories. Standard curves made up in different human fasting sera have a scatter only within the range of pipetting and counting error. (auth)

23138 NUCLEAR MEDICAL ASPECTS OF CLINICAL OSTEOLOGY. Schneider, C. (Hamburg Univ. (F. R. Germany). Radiologische Klinik und Strahleninstitut). Z. Rheumatol., Suppl.; 33: No. 3, 112-117(1974). (In German).

1 fig., 1 tab.; 31 refs.

Intestinal calcium absorption and enteral and renal excretion can be measured with the help of radioisotopes. The value of calcium accretion in the skeleton can be determined by means of additional long-term measurement of changes in the specific blood activity and a model of calcium metabolism. This value of the skeletal calcium accretion can be considered as a distinct parameter of the overall bone forming processes and can thus be of great help in clinical diagnostics. Scintigraphic methods lend themselves to detect localized enhancements of the osseous metabolism and represent an important measure supplementing x-ray diagnoses in the detection of skeletal metastases and inflammations. (GE)

23139 SCINTIGRAPHY OF BONE-TECHNICAL BASIS AND CLINICAL INDICATION. Georgi, P. (Deutsches Krebsforschungszentrum, Heidelberg (F. R. Germany). Inst. fuer Nuklearmedizin). Roentgen Bl.; 27: No. 10, 475-481(Oct 1974). (In German).

6 figs.; 11 refs.

Scintigraphy of bone using short-lived osteotropic radionuclides is a technique which, with little exposure to radiation, permits early detection of circumscribed foci, either due to growths or infection. It is also of value for establishing the extent of bone involvement and for assessing local bone metabolism. (GE)

23140 RADIOIMMUNOLOGICAL DETERMINATION OF TRIIODOTHYRONINE IN SERUM. Nauman, A.; Nauman, J. (Centrum Medyczne Ksztalcenia Podyplomowego, Warsaw (Poland)). Pol. Arch. Med. Wewn.; 50: 1295-1304(1973). (In Polish).

A sensitive and specific radioimmunological method for direct determination of triiodothyronine in the serum is reported. The method enables repeated determinations of triiodothyronine in concentrations of 2.0 to 4.0 pg to be carried out in 0.02 ml of serum. Cross-binding with thyroxine ranges from 0.2% to 0.4% and depends on the presence of T_3 in standard T_4. The T_3-TBG bond is blocked by thiomersal introduced into this system and use of buffers of pH 9.0. The mean recovery of added exogenous T_3 is 102.4%. Determinations performed in 41 healthy subjects showed that serum T_3 levels range from 0.92 ng/ml to 1.95 ng/ml being 1.415 ± 0.319 ng/ml on the average. The investigations carried out on patients with thyroid diseases demonstrated that T_3 level was raised in hyperthyroidism and decreased in hypothyroidism. (auth)

23141 ^{113m}In-RADIOPHARMACEUTICALS FOR PLACENTA AND LIVER SCANNING. Jaiswal, D. K.; Jagdish Chander; Nagpal, K. K.; Bikram Singh; Mazumdar, S. K. (Institute of Nuclear Medicine and Allied Sciences, Delhi (India)). Indian J. Radiol.; 26: No. 4, 299-301(Nov 1972).

The preparation of ^{113m}In-radiopharmaceuticals for placenta and liver on laboratory basis is described. Their application in organ scanning is discussed. (auth)

23142 INCORPORATION OF RADIOACTIVE PRODUCTS OF PHOTOSYNTHESIS INTO LIGNIN AND CELLULOSE OF SCOTS PINE (PINUS SILVESTRIS L.) SEEDLINGS. Goral, I. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw (Poland)). Acta Soc. Bot. Pol.; 42: 555-565(1973).

Distribution of radioactive photosynthetic products as well as their utilization in biosynthesis of lignin and cellulose in one-

year-old pine seedlings was investigated at different growth stages. Time of metabolization and the rate of photosynthetic products incorporation into lignin and cellulose depend on the organ and on the kind of polymer synthetized. (auth)

23143 DISTRIBUTION OF RADIOACTIVE PRODUCTS OF PHOTOSYNTHESIS IN SCOTS PINE (PINUS SILVESTRIS L.) SEEDLINGS DURING THE FIRST VEGETATION SEASON. Goral, I. (Szkola Glowna Gospodarstwa Wiejskiego, Warsaw (Poland)). Acta Soc. Bot. Pol.; 42: 541-553(1973).

Dynamics of translocation and distribution of radioactive photosynthetic products in one year old pine (P. silvestris L.) seedlings was investigated at different growth stages. Utilization of photosynthetic products in particular organs depends greatly on the growth stage. Losses of photosynthetic products as a result of respiration were the smallest at the stage of intensive needle growth and the greatest at the stage of approaching dormancy. (auth)

23144 SYNTHESIS AND EVALUATION OF POTENTIAL PANCREATOTROPHIC RADIOPHARMACEUTICALS. Burns, H. D. Bethlehem, PA; Lehigh Univ. (1974). 135p. University Microfilms Order No. 75-4720.

Thesis (Ph. D.).

In the search for a γ-emitting radiopharmaceutical suitable for imaging the pancreas by scintillation scanning or gamma-camera methods, a number of new candidate agents were synthesized and evaluated. These agents were structural models of known hypoglycemics, hyperglycemics and pancreatic stimulatory hormones. Using tolbutamide and/or glycodiazine as the prototype pancreatic hypoglycemic, 5 analogues were prepared which would be capable of carrying ^{99m}Tc in cationic state as a chelating ligand. In a rat glucose tolerance assay, two of these were found to display potency, one equal to tolbutamide itself, and these two were then selected for more detailed tissue distribution studies. In the course of preparing the labeled chelate, several literature methods for preparation of such ^{99m}Tc-tagged agents were evaluated. It was determined that the most suitable procedure for labeling compounds of the type described herein involved a stannous chloride reduction of pertechnetate ion in the presence of the desired ligand, followed by purification via gel filtration chromatography. Tissue distribution studies on these chelates showed a very high uptake in the kidney and a pancreas/liver ratio of less than 1.0, indicating that such chelates would be unsuitable for imaging normal pancreatic tissue. Gastrin tetrapeptide—the carboxyl terminal tetrapeptide from the pancreatic stimulatory hormone gastrin—was also labeled by the procedure described above and tissue distribution studies performed. Again, the highest concentration was found to be in the kidney, and a pancreas/liver ratio of less than unity was obtained. For a model hyperglycemic agent, the diabetogenic antibiotic streptozotocin was selected as a prototype for synthetic modification. Initial studies showed that streptozotocin itself could not be directly labeled by chelation or iodination. Therefore a number of analogues of this antibiotic were synthesized which would be expected to label with ^{131}I (either by iodide displacement of a labile chlorine atom or by electrophilic iodination with iodine monochloride. One of these analogues displayed a unique physiological effect in that it caused a transient diabetic effect in mice, with glucose metabolism returning to normal after several days. This same compound, while giving a pancreas/liver ratio of approximately one in normal rats, yielded a pancreas/liver ratio of approximately three in hamsters with adenocarcinoma of the pancreas during preliminary testing. Furthermore, a tumor to benign tissue ratio of nearly three was also obtained. These results are viewed as quite promising since such localization would result in the tumor appearing as a "hot spot" on a scintiphoto or scan. (Diss. Abstr. Int., B)

23145 AGE DETERMINATIONS BY THE ^{176}Lu–^{176}Hf METHOD. Owen, L. B. Columbus, OH; Ohio State Univ. (1974). 300p. University Microfilms Order No. 75-3162.

Thesis (Ph. D.).

The β^- decay of naturally-occurring ^{176}Lu to stable ^{176}Hf is a potentially useful geochronometer for dating lutetium-bearing rocks and minerals. Published half-life determinations for ^{176}Lu indicate that it has a value of either 22 or 30 to 40 billion years. In order to use this geochronometer, lutetium, hafnium, and the radiogenic component ^{176}Hf, expressed in terms of the ^{176}Hf/^{177}Hf isotopic ratio, must be determined. Development of a ^{176}Lu/^{176}Hf geochronometer has been impeded primarily by the analytical difficulties associated with determining the isotopic composition of hafnium. Silicate rocks and spikes (^{176}Lu or ^{179}Hf) and tracer, in the case of lutetium, were fused with a mixture of 40% boric acid and 60% lithium fluoride. Apatite samples were dissolved with 6N hydrochloric acid and, in the case of hafnium, equilibrated with spikes by addition of 0.5N oxalic acid. Lutetium was extracted by a simple cation exchange procedure involving the use of 6.9 day ^{177}Lu tracer. Isobaric interference from ^{176}Yb was eliminated in the mass spectrometer by quantitative removal of ytterbium at a filament temperature too low to produce lutetium ion emission. Hafnium and zirconium were separated from other elements by precipitation of cupferrates, followed by cation exchange chromatography with 4.0N nitric acid. An advantage of this procedure is that hafnium and zirconium may be determined simultaneously if samples are spiked for zirconium (^{91}Zr spike), because zirconium ion emission occurs at a significantly lower temperature than required for hafnium. Concentrations of hafnium and zirconium were calculated from the measured ^{179}Hf/^{180}Hf and ^{91}Zr/^{90}Zr isotopic ratios, respectively. The procedures were tested by analysis of a suite of rock standards, and the results were in satisfactory agreement with previous determinations. Apatite, nepheline syenite, and ijolite from the Lackner Lake Complex contain hafnium which is measurably enriched in radiogenic ^{176}Hf compared to "spec-pure" hafnium oxychloride reagent. The isochron indicates a date of 1009 ± 77 million years assuming a half-life of 3.53×10^{10} years for ^{176}Lu. If a half-life of 2.2×10^{10} years is used the date calculated for the complex is too low (627 million years). The initial ratio of 0.3008 is significantly greater than the nominal crustal ^{176}Hf/^{177}Hf ratio of 0.2811 as indicated by hafnium reagent. As a consequence, it was concluded that the mantle may be enriched in radiogenic hafnium. High concentrations of lutetium have been reported in the literature for apatite and garnet. This suggests that potentially important applications for a ^{176}Lu/^{176}Hf geochronometer are the dating of apatite-bearing rocks, including sedimentary phosphate deposits, and metamorphic rocks enriched in garnet. (Diss. Abstr. Int., B)

MATERIALS

23146 (AD-785446) MATERIALS RESEARCH AT STANFORD UNIVERSITY. Report No. 13 (Annual), 1 July 1973–30 June 1974. (Stanford Univ., Calif. (USA)). Aug 1974. 374p. (CMR-74-9). NTIS $8.00.

Various individual research programs are arranged alphabetically by the name of the principal investigator. Also included are lists of publications, doctoral dissertations, faculty and senior staff members, research associates, graduate students, and degrees awarded. Finally, a name index is included locating references to the activities of specific individuals. (GRA)

23147 (AD-786926) ANALYTICAL RELATIONSHIPS FOR ESTIMATING THE EFFECTS OF X-RAYS ON MATERIALS. Special Report. Langley, R. W. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif. (USA)). Sep 1974. Contract F04611-73-C-0042. 97p. (AFRPL-TR-74-52). NTIS $4.75.

The report summarizes analytical relationships derived for estimating the effects of x-rays on materials. The effects covered include energy deposition in single and multiple materials, front-face mass removal structural heating, blowoff impluse, stress generation by impulse loads and thermal loads, stress wave attenuation in undistended and distended materials, and structural response. Optimum energy spectra which maximize an effect for a given fluence are emphasized; however, specific spectra are also treated. (GRA)

23148 THEORY OF VISCOPLASTICITY OF IRRADIATED MATERIALS. Perzyna, P. (Instytut Podstawowych Problemow Techniki, Warsaw). Arch. Mech. Stosow.; 26: No. 1, 81-93 (1974).

The mathematical structure of a thermodynamic theory of viscoplasticity of irradiated materials using an internal variable description is presented. A set of rules of interpretation for internal state variables introduced is given, based on the analysis of dissipative mechanisms for time-dependent plastic flow of irradiated materials and on available experimental data. The thermal activation process and damping of dislocation motion by phonon viscosity are assumed to be the most important mechanisms for proper explanation of the strain rate and temperature sensitivity of irradiated materials. (auth)

Ceramics and Cermets

Refer also to abstracts 22055, 22088, 22126, 22141, 23149, 23209, 23210, 23216–23219, 23231, 23280, 23337, 23355, 23368, 24642, and 25024.

23149 (AD-786031) PREPARATION AND PROPERTIES OF FINE DIAMETER MULTIFILAMENT NIOBIUM CARBONITRIDE SUPER-CONDUCTING FIBERS. Final Technical Report, 1 April 1973–31 March 1974. Lin, R. Y.; Smith, W. D.; Coppola, J.; Economy, J. (Carborundum Co., Niagara Falls, N. Y. (USA). Research and Development Div.; Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). Jun 1974. Contract F33615-73-C-5110. 73p. (AFML-TR-74-113). NTIS $4.25.

Development efforts on niobium carbonitride yarn are summarized. The preparation was accomplished by reacting the carbon fiber precursor with niobium pentachloride in the presence of hydrogen and nitrogen at 1500 to 1600°C for 2 to 6 minutes. The reacted yarn was quenched from the reaction temperature to about 200°C to retain the niobium carbonitride phase. These fibers display excellent superconducting properties. A post treatment with ammonia was found to cause a composition change yielding a nitrogen-rich product via a further nitriding process. The critical current and current density of the typical products were increased. Silicon dopant was found to be effective in improving the critical current at high magnetic fields. Improvement in electrical contact between the superconductor and copper coating was accomplished by a post coating heat treatment in the temperature range of 600 to 1000°C in the inert atmosphere. (GRA)

23150 (AD-787642) DEVELOPMENT OF MATERIALS RESISTANT TO WEAR AND CORROSION FOR MECHANICAL-FACE-SEAL APPLICATIONS. Research and Development Report. Vreeland, D. C.; Miller, B. E.; Carroll, J. (Hydrocarbon Research, Inc., Trenton, N. J. (USA)). Nov 1974. 19p. (NSRDC-4299). NTIS $3.25.

Two new compositions of hard-facing alloys and one cermet were developed as corrosion- and wear-resistant materials for mechanical-face-seal applications. After showing excellent resistance to localized corrosion, in a newly developed laboratory test, the hard-facing alloys were fabricated in the form of weld rods by a casting process and in the form of powders by an atomization process. The weld rods were used with the gas tungsten-arc process to make successful weld deposits on Inconel 625 coupons. The powders were applied by a plasma weld-surfacing technique to Inconel 625. A special cermet was developed for possible use as a mechanical-face-seal wearing surface. The cermet showed excellent properties in wear tests and in laboratory and sea-water corrosion tests. (GRA)

23151 (AERE-R-7804) SOME OBSERVATIONS ON THE MICROSTRUCTURES OF MIXED CARBIDE FUEL IRRADIATED UP TO 10% BURNUP OF HEAVY ATOMS. Paris, R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1974. 15p. Dep. NTIS (US Sales Only) $4.00.

Mixed carbide fuel has been examined by optical metallography after DFR irradiation from 1 to 10% burn up. Second phase depletion, fission gas bubble formation, and solid fission product precipitation are described. Dicarbide completely disappeared during irradiation while sesquicarbide disappeared from hot regions only. The onset of optically visible fission gas bubbles was temperature and burn up dependent. Below 1000°C peak center temperature grain boundary gas bubble linkage is believed to have occurred above about 9% burn up. All grains in low temperature fuel were fissured at 10 % burn up; the stresses associated with an asymmetrical temperature distribution are believed to have been responsible. Precipitates rich in intermetallic fission products were present in the hot regions of fuel above 4.6% burn up but in no cases were they observed in specimens irradiated below about 900°C. They were often concentrated in a band around the limit of visible gas bubble formation suggesting vapor phase migration down the temperature gradient along the interconnected fission gas passages. Microprobe analysis of large inclusions revealed the presence of Pu, U, La, Ce, Nd, Pr, Ru, Ph, and Pd. (auth)

23152 (ANL-Trans-972) TRANSPIRATION STUDY OF THE URANIUM DIOXIDE VAPORIZATION PROCESS BETWEEN 2200 AND 2600°K. Benezech, G.; Coutures, J. P.; Foex, M. 1974. Translation of SM-190/27. (CONF-741030-7). 13p. Dep. NTIS $4.00.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

The vapor pressure over UO_{3-x} was investigated in $Ar-H_2$ using a solar furnace and a transpiration device. Partial pressures of the gaseous species O, O_2, U, UO, UO_2, and UO_3 were determined at 2120 to 2570°K. Vaporization enthalpy and entropy were also determined. The vapor pressure above UO_2 in Ar–5% H_2 is $\log_{10} p = -27,135/t + 7.102$. (DLC)

23153 (COO-1198-1127) HIGH TEMPERATURE DEFORMATION BEHAVIOR OF CEMENTED CARBIDE CUTTING TOOLS. Baldoni, J. G. II. (Illinois Univ., Urbana (USA)). Jan 1975. Contract AT(11-1)-1198. 182p. Dep. NTIS $12.25.

Thesis.

Sections of commercial cemented carbide metal cutting tools, both straight WC–Co and multi-carbide–Co, were tested at high temperature, in vacuo, in uniaxial compression. For stresses up to 50 kg/mm^2 and temperatures below approximately 1050°C the materials were found to show elastic response. In the temperature range of 1050 to 1200°C, irreversible deformation was observed at stress levels below 50 kg/mm^2. The temperature for the onset of this deformation was found to depend upon composition, increasing with increasing amounts of cubic carbide and decreasing cobalt content. After a certain amount of irreversible deformation, the amount being dependent on composition and temperature, the materials again showed a linear relationship between stress and strain. The amount of irreversible deformation was found to decrease with increasing cubic carbide additions, decreasing cobalt content, and decreasing temperature. The return of the samples to a linear stress–strain relationship is interpreted as the cessation of plastic deformation and the reappearance of elastic response. A model based on densification by grain boundary sliding with accompanying plastic deformation in the binder phase and some deformation of carbide grains at points of contact is presented to explain the observations. Results of studies of carbide grain shapes indicate that gross plastic deformation of the individual grains did not occur at the stress levels and temperatures studied (up to 1200°C) despite the macroscopic changes in shape and dimensions of the samples. (auth)

23154 (COO-1591-25) AMBIPOLAR DIFFUSION AND ITS APPLICATION TO DIFFUSION CREEP. Gordon, R. S. (Utah Univ., Salt Lake City (USA). Div. of Materials Science and Engi-

neering). May 1974. Contract AT(11-1)-1591. 37p. (CONF-740672-2; UTEC-MSE-74-067). Dep. NTIS $5.00.

From conference on ceramic science transport phenomena in ceramics; Cleveland, Ohio, USA (3 Jun 1974).

A diffusional creep theory which takes into account the simultaneous occurrence of lattice and grain boundary diffusion for both anions and cations was developed for a polycrystalline ionic compound. The effects of grain size, soluble cation impurities of variable valence, and oxygen partial pressure on the relative contributions of lattice and grain boundary diffusion of the different ionic species were analyzed. Diffusional creep data for pure and doped, polycrystalline MgO, Al_2O_3, and BeO were analyzed in terms of various limiting conditions of the general creep theory. (auth)

23155 (ERDA-tr-9) INVESTIGATION OF METHODS OF MANUFACTURING FAST REACTOR FUEL ELEMENT PINS FROM URANIUM MONOCARBIDE, MONONITRIDE, AND CARBONITRIDE. Reshetnikov, F. G. Jan 1975. Translated by W. J. Grimes from pp 25-46 of STI/PUB-346(Vol.2). (CONF-730726-26). 33p. Dep. NTIS $4.75.

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973).

This paper considers the basic theory of processes for making refractory compounds from UO_2 in fluidized beds in different gas atmospheres, a continuous production process for U_2N_3 based on the interaction of uranium metal with gaseous reagents, a continuous production process for UC and nitride based on the interaction of UO_2 with C in different gas atmospheres, and the relative characteristics of monocarbide, carbonitride, and mononitride powders obtained by different methods (specific area, grain size, grain shape, bulk density, chemical, and spectral analysis). Different methods of forming billets for subsequent sintering are described and the effect of the forming pressure and the quantity and nature of the binding agent on the density, mechanical strength, and elastic creep of the billets is discussed. Results are presented of an investigation of the effect of sintering conditions, powder grain size, impurity content, and type of atmosphere on the density, structure, shrinkage, geometrical accuracy, and phase composition; the possibility of combining the compound-producing and sintering processes is examined. Finally, the statistical characteristics of sintered pins, such as density, size, and composition distributions are considered and the filling densities of cans with pellet and rod type pins are compared. (13 fig) (auth)

23156 (GEMP-66) AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM PROGRESS REPORT NO. 66, JANUARY 1-MARCH 31, 1967. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 May 1967. Contract AT(40-1)-2847. 75p. Dep. NTIS $6.75.

Declassified 10 Sep 1973.

Research programs are summarized on substoichiometric urania, urania solid solutions, W-UO_2 cermets, W-UO_2-ThO_2 cermets, moderator materials, control materials, shielding materials, and fission product diffusion in refractory alloys. (JRD)

23157 (GEMP-104) TESTING OF FUELED BeO AT HIGH PRESSURE IN FIVE DIFFERENT ENVIRONMENTS. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). Jan 1962. Contract AT(40-1)-2847. 23p. Dep. NTIS $4.25.

Declassified 20 Sep 1973.

The testing of BeO fueled with 10 weight percent UO_2, added as 45 weight percent UO_2 and 55 weight percent Y_2O_3, in environments of air, nitrogen, carbon dioxide, helium, and a mixture of air and helium at 300 psi is described. Tests were run for 25 hours at 1090 and 1370°C using each of these environments. The results showed over-all physical integrity to be excellent, the primary change being the loss of strength ranging from 4 to 41 percent; however, the atmospheres and pressure used generally resulted in no greater change in strength than that resulting from a thermal soak in air at 1090 and 1370°C at atmospheric pressure. (auth)

23158 (JUL-953-AC) MASS-SPECTROMETRIC HIGH-TEMPERATURE EXPERIMENTS FOR THE STUDY OF THE RETENTION MECHANISM OF SOLID FISSION PRODUCTS IN UO_2 FUEL PARTICLES BY MEANS OF Al_2O_3 ADDITION. Hilpert, K.; Nuernberg, H. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Analytische Chemie; Bonn Univ. (F. R. Germany)). May 1973. 239p. (In German). INIS.

Thesis by K. Hilpert.

The pyrocarbon coating of the UO_2 fuel particles used for high-temperature fuel elements (coated fuel particles) does not form an absolutely safe barrier above 1,573 K for certain fission products, e.g., Sr, Ba and Ce. By the addition of Al_2O_3 to the UO_2 fuel, the release of these fission products, however, can be diminished by orders of magnitude. The reason for this is the participation of the Al_2O_3 in solid chemical reactions with the fission products (spinel formation). The vaporization behavior of BaO in uncoated model fuel particles as well as in coated ones, with and without Al_2O_3 addition was investigated. Particular attention is paid to the compound formation in the binary system BaO-Al_2O_3 and to its specific temperature-dependent behavior. High-temperature mass spectrometry is applied using different variants of Knudsen cells to measure the partial pressures of the vaporizing molecules as a function of temperature. From the measured results, a series of thermodynamic data are calculated (reaction enthalpies, free reaction enthalpies and reaction entropies belonging to the vaporization reactions) and barium oxide decomposition pressures belonging to different barium aluminates are determined. Thermodynamic functions for the formation of $BaAl_2O_4$ and $BaAl_{12}O_{19}$ from the oxides or elements are also determined from these data. Particular computer programs are set up for the calculations. Measured results and model considerations of the work permit a more profound understanding of the Ba retention effect in fuel particles influenced by the addition of Al_2O_3. (GE)

23159 (N-74-27177) OUT-OF-PILE CREEP BEHAVIOR OF URANIUM CARBIDE. Summary Report, 1 July 1972-30 June 1973. Wright, T. R.; Seltzer, M. S. (Battelle Columbus Labs., Ohio (USA)). 1974. Contract NAS3-16776. 100p. (NASA-CR-134588). NTIS $8.00.

Compression creep tests were investigated on various UC-based fuel materials having a variation in both density and composition. Specimens were prepared by casting and by hot pressing. Steady-state creep rates were measured under vacuum at 1400 to 1800°C in the stress range 500-4000 psi. (auth)

23160 (N-74-29983) FREE ENERGIES OF FORMATION OF WC AND W_2C AND THE THERMODYNAMIC PROPERTIES OF CARBON IN SOLID TUNGSTEN. Gupta, D. K.; Seigle, L. L. (State Univ. of New York, Stony Brook (USA)). 1974. 26p. (NASA-CR-139406). NTIS $4.50.

The activity of carbon in the two-phase regions W + WC and W + W_2C was obtained from the carbon content of iron rods equilibrated with mixtures of metal plus carbide powders. From this activity data, the standard free energies of formation of WC and W_2C were calculated. The temperature of the invariant reaction W_2C = W + WC was fixed at 1570 ± 5°K. Using available solubility data for C in solid W, the partial molar free energy of C in the dilute solid solution was also calculated. The heat of solution of C in W, and the excess entropy for the interstitial solid solution, were computed, assuming that the carbon atoms reside in the octahedral interstices of bcc W. (auth)

23161 (TID/SNW-19) EVALUATION OF GLASS SEALS FOR ELECTRICAL CABLES. Grekila, R. B.; Seidel, J.; Bush, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 16 Jul 1965. 23p. Dep NTIS $4.25.

Previously developed vacuum-tight seals for stainless-steel-sheathed, MgO-insulated copper conductors were prepared and tested. Electrical resistance, leakage under vacuum and pressure, and thermal and mechanical shock were measured to evaluate the reliability of the sealing technique. (auth)

23162 SOME OBSERVATIONS OF DENSITY AND POROSITY CHANGES IN UO_2 FUEL IRRADIATED IN WATER-COOLED REACTORS. Banks, D. A. (UKAEA). J. Nucl. Mater.; 54: No. 1, 97-107(Nov 1974).

A technique was developed for the hot-cell measurement of the apparent density of irradiated UO_2 fuel extraction from a fuel pin. A single determination is accurate to ±3% at the 95% confidence limit. The method was applied to fuel irradiated in thermal neutron fluxes in the Winfrith SGHWR and in the Halden BWR. Material was examined at ratings of 1 to 51 W/g and in the burn-up range $0.09 - 5.79 \times 10^{20}$ fissions/cm^3. It is concluded that pellets with peak temperatures below 1100°C densify during irradiation, but at higher temperatures the pellets begin to swell. Fuel micrography shows that the densification is principally due to the loss of micropores with a temperature dependency given by an activation energy of 5200 cal/mol. Above 1000°C the densification is masked by the formation and growth of intergranular fission gas bubbles, whose volume may exceed that of the manufactured pores which have sintered. In solid fuel pellets central swelling did not balance densification in the cooler rim until the fuel center temperature exceeded 1700°C. (auth)

23163 HEAT TRANSFER AND THERMAL CONDUCTIVITY OF MULTI-HUNDRED WATT $^{238}PuO_2$ FUEL SPHERES. Tennery, V. J. (Mound Lab., Miamisburg, Ohio (USA)). J. Nucl. Mater.; 54: No. 1, 73-78(Nov 1974).

The thermal conductivity of porous $^{238}PuO_2$ was calculated from steady-state core and surface temperatures in spheres having diameters of ~3 and ~3.7 cm assuming linear heat transfer at the sphere surface. The spherical fuel forms had densities of 80 to 85% of T.D. for PuO_2 (T.D. = 11.41 g/cm^3). Thermal conductivity in the fuel increased nearly linearly with $[T_{avg}(K)]^{1/2}$ in the range 350 to 1100°C and thus was dominated by a gas phase present in the open and closed porosity of the fuel. For spheres heated in helium or vacuum, the gas phase had essentially three degrees of freedom. When the fuel was heated in argon saturated with water vapor, approximately 50 degrees of freedom were indicated and this was apparently largely due to the water vapor. A two-phase, series slab heat flow model adequately predicted the thermal conductivity of the $^{238}PuO_2$ phase as a function of temperature. (auth)

23164 CRACK FORMATION, CRACK HEALING AND POROSITY REDISTRIBUTION DURING IRRADIATION OF UO_2 AND $(U,Pu)O_2$. Hoffmann, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). J. Nucl. Mater.; 54: No. 1, 9-23(Nov 1974).

The irradiation-induced void volume redistribution in the fuel was analyzed. The radial crack volume and porosity distributions, the central radii and the radial gap width were measured after irradiation and compared with the calculated values. Short-time (He-loop experiments in the FR2 reactor), medium-time (bundle irradiation in the BR2 reactor) and long-time (trefoil-irradiation in the DFR reactor) irradiated fuel pins were examined. The model of pore migration, used in the computer code SATURN-1a, is based on the evaporation-condensation mechanism. Measured swelling rates were extrapolated to higher temperatures and used. The crack volume distribution was calculated on the basis of a multifractured fuel model. One can conclude from the comparison between calculated and measured void volume distributions that several mechanisms redistribute void volume. These are crack formation, crack healing, migration of sinter pores and fission gas bubbles, gas swelling, evaporation-condensation phenomena in the region of the central void, irradiation-induced sintering and increase in diameter of the cladding. (auth)

23165 URANIUM SELF-DIFFUSION IN IMPURITY-DOPED URANIUM CARBIDE. Routbort, J. L.; Matzke, Hj. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). J. Nucl. Mater.; 54: No. 1, 1-8(Nov 1974).

The tracer diffusion of uranium-233 in arc-cast uranium carbide doped with 0.3 to 2.0 wt % tungsten, 0.15 and 2.4 wt % tantalum, and 0.5 wt % vanadium has been investigated in the temperature range of 1300 to 2250°C using high-resolution α-spectroscopy. A comparison of the results with those obtained from pure UC appropriately corrected for the dependence of the diffusivity on the carbon-to-uranium ratio shows that uranium mobility is enhanced ($\sim 10^2 - 10^3$) at lower temperatures. The enhancement decreases as temperature is increased. These results tend to substantiate the fact that the low-temperature extrinsic diffusion region which has been observed in arc-cast UC is caused by a vacancy–impurity interaction. (auth)

23166 MECHANISTIC STUDY OF OXYGEN THERMAL DIFFUSION IN HYPERSTOICHIOMETRIC URANIA AND URANIA-PLUTONIA SOLID SOLUTIONS. Adamson, M. G. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center); Carney, R.F.A. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). J. Nucl. Mater.; 54: No. 1, 121-137(Nov 1974).

Sintered specimens of hyperstoichiometric urania (O/U = 2.035 to 2.045) and urania–plutonia solid solutions (15 mol % Pu, O/M = 2.003 to 2.061) were subjected to longitudinal thermal gradients between 750 and 1580°C in sealed noble metal capsules. Annular UO_{2+x} samples were equilibrated in radial thermal gradients of 1000 to 2025°C in localized inert gas/CO–CO_2 atm. The results show when impurity carbon is present at levels as low as 3 ppm, a stoichiometry gradient is produced in the solid by oxygen migrating from cool to hot regions. Below 1600°C, oxygen migration occurs almost exclusively through the CO + CO_2 gas mixture generated by reaction between UO_{2+x} and the carbon impurity. Above 1600°C, a UO_3 distillation path contributes significantly to the overall thermal diffusion process. The experimental data are compared with predicted heats of transport. Some special features of the CO/CO_2 oxygen distribution mechanism are discussed, and some new oxygen potential data are presented for hyperstoichiometric mixed oxide between 1350 and 1500°C. (auth)

23167 BUBBLE-PRECIPITATE INTERACTION ON GRAIN BOUNDARIES IN IRRADIATED UO_2. Hastings, I. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 54: No. 1, 138-140(Nov 1974).

The observation of a feature which may contribute to the immobility of grain boundary bubbles in UO_2 at temperatures below about 1900 K is reported. Precipitates, probably solid fission products, appear to be restraining grain boundary bubbles that could otherwise migrate up a temperature gradient. For the bubble sizes and density observed, interlinking occurs before the bubbles grow large enough to break away from the precipitates. Alternatively, cracking accompanying reactor shutdown could permit gas release before interlinking occurred. The observations support a model such as that of Beere and Reynolds (1973) which proposes an incubation period for bubble growth on, and subsequent gas release from, grain boundaries in irradiated UO_2. (auth)

23168 INFLUENCE OF FLUORIDE ON HOT-PRESSED DENSITY OF URANIUM DIOXIDE. Adams, R. B. (Chemical Technology Division, Australian Atomic Energy Commission, Sutherland, NSW, Australia). J. Nucl. Mater.; 54: No. 1, 169-170(Nov 1974).

The favorable effects of fluoride on the hot-pressed density of a grade of UO_2 which is otherwise difficult to fabricate are described. (auth)

23169 BEHAVIOR OF THE $Dy_2O_3-Al_2O_3$ COMPOUNDS IN UO_2. Gilissen, R.; Flipot, A. J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). J. Nucl. Mater.; 54: No. 1, 166-168 (Nov 1974).

The behavior of $2Dy_2O_3 \cdot Al_2O_3$, $Dy_2O_3 \cdot Al_2O_3$ and $3Dy_2O_3 \cdot 5Al_2O_3$ in uranium dioxide was examined in the context of the use of dysprosium as a burnable poison in oxide nuclear fuels. (auth)

23170 COMMENTS ON SARIAN'S PAPER "KINETICS AND MECHANISMS OF CARBON SELF-DIFFUSION IN URANIUM CARBIDES". Son, P.; Sano, T. (Osaka Univ., Suita (Japan). Faculty of Engineering). J. Nucl. Mater.; 54: No. 1, 146-150 (Nov 1974).

In previous papers the authors have proposed that diffusion of carbon in UC takes place by an interstitial or an interstitialcy mechanism to account for the variation of diffusion coefficient with carbon content. In contradiction to their view, Sarian in a recent article, (J. Nucl. Mater. 49, 291 (1973/74)) suggested that in hypo-UC_x carbon atoms diffuse by a vacancy mechanism and in hyper-UC_x diffusion occurs by migration of single carbon atoms from doubly occupied octahedral sites to adjacent singly occupied octahedral sites. Although it is based on Zener's theory of the pre-exponential factor, Sarian's argument contains many questionable assumptions and deductions, which one cannot overlook. This note clarifies the errors and fallacies implied in Sarian's article in detail. (auth)

23171 PROTON CHANNELING IN URANIUM MONONITRIDE. Nasu, S.; Kurasawa, T.; Ozawa, K.; Shiozawa, K.; Kawatsura, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Komaki, K. (Tokyo Univ. (Japan). Coll. of General Education); Takada, T. (Nagoya Univ. (Japan)). J. Nucl. Mater.; 54: No. 1, 143-145(Nov 1974).

Channeling studies on nuclear fuels such as UO_2, U_4O_9 and UC were performed. In addition to these studies, the channeling technique was used to study the formation of oxide layers on UC single crystals and the position of rare gas atoms in UC single crystals. This investigation presents channeling data on uranium mononitride, UN, of the NaCl-type structure with partly covalent and partly metallic bonds. (auth)

23172 DIFFUSION OF TUNGSTEN IN URANIUM CARBIDE CRYSTALS. Matzke, H.; Routbort, J.; Jupe, S. (European Inst. for Transuranium Elements (EURATOM), Karlsruhe, Ger.). J. Less-Common Metals; 40: No. 1, 156-160(Mar 1975).

^{185}W was evaporated onto polished surfaces of UC single crystals, and diffusion anneals were carried out at 1750 to 2095°C. Beta particles from ^{185}W decay were used as tracer. An experiment was also conducted on $UC_{0.93}$ at 1740°C. The activation energy for W diffusion is 188 ± 17 kcal/mole. The enhancement ratio D^W_{UC}/D^V_{UC} is between 14 and 38. (DLC)

23173 THERMAL CONDUCTIVITY OF METAL DODECABORIDES WITH A UB_{12} STRUCTURE. Odintsov, V. V.; Lesnaya, M. L.; L'vov, S. N. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 834-835(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 194(Sep 1973). This is a summary of paper No. 690/7250 with full copy held at TIC.

Temperature dependences of the electrical resistivities and thermal conductivities of YB_{12}, ZrB_{12}, DyB_{12}, HoB_{12}, ErB_{12}, TmB_{12} were determined at 300 to 1000°K. The electrical resistivity increases linearly with temperature for all compounds. The thermal conductivity decreases with temperature, leveling off at a constant value at the higher temperatures; the lattice is indicated to be fairly rigid. (DLC)

23174 STUDY OF THE SYSTEM $V_2O_5-Na_2O$. II. Physicochemical Properties of the Molten $V_2O_5-NaVO_3$ Mixtures. Danek, V. (Inst. of Inorganic Chemistry, Bratislava); Votava, I.; Matiasovsky, K.; Balajka, J. Chem. Zvesti; 28: No. 6, 728-732(1974).

The density, viscosity, and specific electrical conductivity of the molten $V_2O_5-NaVO_3$ mixtures at 650 to 900°C were measured. It was found that in the range of the existence of vanadium bronze, $Na_{0.23}V_2O_5$, a stable redox system V^{IV}/V^V is formed in the investigated system which brings about a partial electronic conductance of the melt. The mechanism of the vanadium corrosion and the influence of the electronic conductivity on the corrosion process are discussed. (auth)

23175 CRITICAL CONCENTRATION FOR MAGNETIC ORDER IN SOLID SOLUTIONS OF UO_2 WITH ThO_2 AND ZrO_2. Sabine, T. M.; Smith, G. B.; Reeve, K. D. (New South Wales Inst. of Tech., Broadway, Australia). J. Phys., C (London); 7: No. 24, 4513-4521(21 Dec 1974).

Changes in Néel temperature and the changes in the localized magnetic moment on the uranium ion in solid solutions of UO_2 with ZrO_2 and ThO_2 were measured by neutron diffraction methods. The localized magnetic moment per uranium atom falls immediately when UO_2 is diluted and vanishes well before the expected critical concentration for the breakdown of long-range order. These observations are shown to be consistent with spin-lattice interaction effects. (auth)

23176 OXIDATION OF ZIRCONIUM CARBIDE ON REACTION WITH SHOCK WAVES. Brevsov, O. N.; Tatsii, V. F. Zh. Neorg. Khim.; 19: No. 11, 2928-2931(Nov 1974). (In Russian).

A study was carried out on ZrC samples subjected to shock waves having an amplitude in the interval of 160 to 350 kbar. The shock-wave treatment noticeably increases the rate of oxidation. On oxidizing ZrC a cubic zirconium dioxide is formed with lattice parameter a = 5.10 + 0.02 Å. (tr-auth)

23177 AGGLOMERATION OF UO_2 FOR CORE FUEL. Susnik, D.; Kolar, D.; Holc, J. (Ljubljana Univ., Yugoslavia). Tehnika (Belgrade); 28: No. 4, 89-92(1973). (In French).

The preparation of pellets by an agglomeration procedure in a mill is described. The density of the agglomerated pellets is extremely high, 63% of the theoretical density of UO_2. After fritting in hydrogen, the density of the pellets depends on the diameter and is from 92 to 94% of the theoretical density. (tr-auth)

23178 LATTICE IMAGES OF $Nb_{22}O_{54}$ AND V_6O_{13} IN THE 1000 kV ELECTRON. Horiuchi, S.; Matsui, Y. (National Inst. for Researches in Inorgainic Materials, Ibaraki, Japan). Phil. Mag.; 30: No. 4, 777-787(Oct 1974).

The resolution limit for the 1000-kV electron microscope equipped with a goniometer stage is 2 Å which is about half that for the 100-kV instrument. The crystal structure of $Nb_{22}O_{54}$ was resolved in detail in a two-dimensional lattice image by the 1000-kV electron microscope; the potential distribution of oxygen ions appeared to be imaged to some extent in addition to that of the niobium ions. Effect of defocus and aperture size on the image contrast could be explained qualitatively on the basis of thin phase object contrast theory. For a V_6O_{13} crystal with a relatively small unit cell, a lattice image exhibiting the crystal structure fairly clearly was obtained with moderately high contrast. (auth)

23179 MAGNETIC SUSCEPTIBILITY OF THE SOLID SOLUTIONS $Ti_2O_3-Al_2O_3$ AND $V_2O_3-Al_2O_3$ AT HIGH TEMPERATURES. Bobrysheva, N. P.; Brach, B. Ya.; Ikorskii, V. N. (Leningrad State Univ.). Zh. Neorg. Khim.; 19: No. 11, 3181-3183(Nov 1974). (In Russian).

On the basis of a study of the magnetic susceptibility of the solid solutions $Ti_2O_3-Al_2O_3$ and $V_2O_3-Al_2O_3$ over a wide interval of temperatures and on considering the dependence of the magnetic susceptibility as a function of the composition of the solid solutions, a possible explanation is advanced for the nature of the phase transitions in the sesquioxides of titanium and vanadium. (SJR)

23180 NEUTRON IRRADIATION DAMAGE IN BORON CARBIDE. Kissinger, H. E. (Battelle Pacific Northwest Labs., Richland, Wash.); Cummings, W. V.; Mahagin, D. E. J. Appl. Crystallogr.; 7: No. 2, 222(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

Boron carbide is a potential neutron-absorber material for fast-reactor control systems. It is, therefore, essential that its response to prolonged fast-neutron irradiation be well characterized. Because of the brittle, frangible nature of B_4C, thinning for microstructural analysis by electron microscopy is a tedious, and frequently unsuccessful, procedure. Small-angle scattering techniques do not require such elaborate sample preparation and have been employed in post-irradiation characterization of irradiated B_4C. Samples irradiated at 760°C to 8×10^{20} captures/cm^3 showed very strong scattering, characteristic of double-Bragg effects. The high-angle diffraction lines were much broadened also. These observations indicated that short-range strain fields were created by the defect configurations present in the sample. The double-Bragg scattering was reduced by post-irradiation annealing and was replaced by a particle-size scattering which could be analyzed by conventional techniques. The nature of the observed scattering was such that the responsible defect configurations must hava a minimum electron density, namely voids, three-dimensional vacancy clusters or helium-filled bubbles. Subsequent transmission electron microscopy confirmed these conclusions. (auth)

23181 ELECTRON IRRADIATION DAMAGE IN QUARTZ. Das, G.; Mitchell, T. W. (Case Western Reserve Univ., Cleveland). Radiat. Eff.; 23: No. 1, 49-52(Sep 1974).

Electron irradiation damage in quartz was studied by transmission electron microscopy as a function of accelerating voltage from 50 to 650 kV at room temperature. Black spot damage was observed at all voltages, the damage rate being faster at higher accelerating voltages. In the voltage range 50 to 100 kV, black spots grew in size with time until they became resolvable as dislocation loops. However, in the higher voltage range, 350 to 650 kV, they were not clearly resolvable as dislocation loops. Additional irradiation at all voltages gradually induced a crystalline-to-amorphous transition when the irradiated area became featureless and the crystalline diffraction pattern was replaced by amorphous rings. It was observed that the dose required for the transformation increased approximately linearly with increasing accelerating voltage. These results are discussed in terms of displacement damage and ionization damage processes. (auth)

23182 OPTICAL EFFECTS IN RUBIES AND LEUKOSAPPHIRES DURING ELECTRON IRRADIATION. Bessonova, T. S.; Stanislavskii, M. P.; Tumanov, V. I.; Khaimov-Mal'kov, V. Ya. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 6, 1201-1204(Jun 1974). (In Russian).

The results of the study of the radioluminescence spectra of leukosapphires and rubies during excitation by fast electrons are reported. The kinetics of the luminescence in different spectral regions were examined. Some data on the induced absorption and thermoluminescence are discussed. An interpretation is given of the phenomena observed, based on the zone model of crystal phosphors. (tr-auth)

23183 ROOM-TEMPERATURE γ-RAY INDUCED SINTERING OF ZINC OXIDE. Wysocki, W.; Sugier, H. (Univ. of Lodz, Poland). Radiochem. Radioanal. Lett.; 20: No. 3, 191-196(3 Feb 1975).

From 24th IUPAC International Congress; Hamburg, Ger. (Sep 1973).

A room-temperature sintering of ZnO powder under the influence of ^{60}Co γ rays was studied. The specific surface area of ZnO as well as the net heat of krypton adsorption on it decreases considerably after irradiation. The effect was explained by smoothing the surface and the formation of neck-joints caused by radiation, which enhanced surface diffusion. (auth)

23184 WEAR-RESISTANT COATINGS FOR REACTOR COMPONENTS. Villat, M. (Sulzer Bros. Ltd., Wintherthur, Switzerland). Sulzer Tech. Rev.; No. 1974, 61-68(1974).

Because the austenitic chromium-nickel steels used in reactor engineering are very prone to seizure, certain sliding parts of the head and foot ends of these guide tubes had to be given a wear-resistant coating. The protective coating and the method for producing it had to satisfy a number of requirements, some of them conflicting. The investigations reported demonstrate that the plasma-sprayed coating applied is equal to the exacting requirements of reactor design. (auth)

23185 MAGNETIC STRUCTURE OF Ba_2MeUO_6(Me = Mn, Co, Ni). Scharf, W.; Weitzel, H. (Technische Univ., Darmstadt, Ger.). Solid State Commun.; 15: No. 11-12, 1831-1836(15 Dec 1974). (In German).

The magnetic structures of Ba_2MeUO_6(Me = Mn, Co, Ni) were determined by means of neutron diffraction. The magnetic moments in the manganese and cobaltous compounds are parallel to each other and lie in planes coupled antiferromagnetically, the Neel temperatures are 12.8°K(Mn) and 8.6°K(Co). The nickel compound orders ferromagnetically below T_N = 20°K. The magnetic moments were found to be $\mu_{Mn} = 4.48\ \mu_B$ and $\mu_U = 0.12\ \mu_B$ in the case of the manganese compound and $\mu_{Co} = 2.70\ \mu_B$ and $\mu_{Ni} = 1.84\ \mu_B$ in the other compounds. (auth)

23186 EPR STUDIES OF A NUCLEAR REACTION IN THE SOLID STATE. McGeehin, P.; Henderson, B. (Univ. of Keele,

Eng.). Solid State Commun.; 15: No. 11-12, 1757-1759(15 Dec 1974).

After extended reactor irradiation single crystals of pure $CaWO_4$ show an EPR spectrum due to Re^{6+} in the distorted tetrahedral $(ReO_4)^{2-}$ complex. The observed concentrations of the two isotopes ^{185}Re and ^{187}Re are in the ratio ~ 1:15; the natural isotopic abundances are in the ratio 4:7. It is shown by consideration of the various nuclear reaction schemes that this spectrum arises from the transmutation of ^{184}W and ^{186}W. (auth)

23187 MAGNETIC SUSCEPTIBILITY OF BkO_2 IN A THORIUM DIOXIDE MATRIX. Karraker, D.G. (Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, South Carolina 29801). J. Chem. Phys. 62: No. 4, 1444-1446 (15 Feb 1975).

Measurements of the magnetic susceptibility of BkO_2 in a ThO_2 matrix from 2.2 to 220°K showed two regions of temperature-dependent paramagnetism: from 10 to 95°K, $\mu_{eff} = 7.66\ \mu_B$, $\theta = 12$°K; from 95 to ~220°K, $\mu_{eff} = 5.8\ \mu_B$, $\theta = -34$°K. Below 10°K, the temperature-dependent behavior was anomalous, caused by a possible antiferromagnetic transition for BkO_2 at 3°K. By fitting the data to a two-level theoretical expression, $g = 5.04$ for the Γ_6 ground level, about 10% higher than the accurate EPR value of 4.488. A $\Gamma_6-\Gamma_8$ energy difference of 80 cm^{-1} was calculated, and the total splitting of the Bk^{4+} $^8S_{7/2}$ ground state in ThO_2 was estimated to be about 300 cm^{-1}. (auth)

23188 SIMULTANEOUS OBSERVATIONS OF PARTIALLY OXIDIZED SURFACES BY AES AND SIMS FOR Al, Si, Ti, V, AND Cr. Komiya, S.; Narusawa, T.; Satake, T. (ULVAC Corporation, Hagisono 2500 Chigasaki, 253 Japan). J. Vac. Sci. Technol. 12: No. 1, 361-365 (Jan 1975).

The advantage of performing simultaneous SIMS and AES analysis together with measurements of sputtering rates is demonstrated by studies of oxidized Al on Si. As the O_{KLL} Auger peak increases, due to increased oxygen coverage, there is enhanced emission of metal ions. Normalized SIMS and Auger signals for Al, Si, Ti, V, and Cr are intrinsic to each metal-oxygen system. From estimates of the escape depth of O_{KLL} Auger electrons, the mean escape depths of metal ions from oxide were estimated. A step-like decrease in sputtering rate is observed and correlated with the thickness of the oxide layer. The Ag-O system was also studied and found to give an anomalous effect. (auth)

23189 MULTIPLE-SCATTERING $X\alpha$ CALCULATIONS ON Al_2O_3 AND Al_2O_2N. Brower, K.L. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 12: No. 1, 458-462 (Jan 1975).

The one-electron energy level structure for single complexes of Al_2O_3 and Al_2O_2N are calculated using the multiple-scattering $X\alpha$ method of Johnson. The results of our calculations on Al_2O_3 are in qualitative agreement with the band structure calculations of Douglas on $\alpha-Al_2O_3$. The results of our calculations on the Al_2O_2N complex suggest that a nitrogen atom substituting for an oxygen atom in sapphire may act as an electron trap or, under either thermal or photon excitation, as an acceptor center. From our calculations the optical spectrum expected for a neutral Al_2O_2N complex in sapphire is predicted. (auth)

23190 THE STRUCTURE OF CO-SPUTTERED TUNGSTEN-ALUMINUM OXIDE GRANULAR FILMS. Pinch, H.L. (RCA Laboratories, Princeton, New Jersey 08540). J. Vac. Sci. Technol. 12: No. 1, 60-62 (Jan 1975).

Tungsten-aluminum oxide granular films with metal volume fraction, x, varying from 0.9 to 0.15 were prepared by an rf sputtering technique in which the entire compositional range was simultaneously deposited. At the metal-rich end the tungsten particles are mainly in the normal bcc form ($\alpha-W$). As x decreases, the amount of tungsten in the β phase (A-15 structure) increases. At $x \sim 0.3$ the tungsten is all $\beta-W$. In the as-prepared films the particle size, as determined by x-ray line broadening, varies from ~65 Å to ~25 Å as x varies from 0.9 to 0.15. Annealing the films results in particle growth and an increase in the amount of α phase. The β phase persists in these granular films to much higher temperatures than reported elsewhere. It is proposed that the metastable $\beta-W$ phase is stabilized by the very small crystallite size. (auth)

23191 ATOMIC IMPLANTATION OF Nb IN AMORPHOUS Nb_2O_5 BY RF SPUTTERING. Fuschillo, N.; Lalevic, B.; Annamalai, N.K. (Electrical Engineering Department, Rutgers University, New Brunswick, New Jersey 08903). J. Vac. Sci. Technol. 12: No. 1, 52-55 (Jan 1975).

It is shown that amorphous Nb_2O_5 films 2400 Å thick produced by anodization can be doped with Nb by rf sputtering of Nb atoms at substrate temperatures of 150°C. Large increases in electrical conductivity, reductions in thermal activation energy, and increases in capacitance as function of sputtering voltage in the range 2-5 kV support this interpretation. The high-field conduction process also changes from the Poole-Frankel mechanism often found in insulating films, where the conductance $G = G_0 \exp(KV^{1/2})$ to the Poole mechanism where $G = G_0 \exp(KV)$ found in Nb doped films. The doping concentration for 2400-Å films was calculated using the experimental values of the exponent K and found to be 10^{19} atoms/cm^3 for films sputtered with Nb at an rf voltage of 3 kV. Capacitance variation as a function of voltage and temperature also support these conclusions. These effects are interpreted on the basis of possible implantation and temperature-aided diffusion process. (auth)

23192 SUPERCONDUCTING TRANSITION TEMPERATURES OF REACTIVELY SPUTTERED FILMS OF TANTALUM NITRIDE AND TUNGSTEN NITRIDE. Kilbane, F.M.; Habig, P.S. (Armco Steel Corporation, Research and Technology, Middletown, Ohio 45043). J. Vac. Sci. Technol. 12: No. 1, 107-109 (Jan 1975).

Superconducting tantalum nitride and tungsten nitride films have been prepared by reactively sputtering the pure metals in argon-nitrogen gas mixtures. X-ray diffraction and Auger electron spectroscopy were used to characterize the deposited compounds. For fcc TaN a maximum T_c of 8.15 K was measured. The high T_c is attributed to achieving a nitrogen content close to the stoichiometric composition. In the tungsten-nitrogen system, a mononitride was not produced. However, superconductivity was found for films in the 5-20 at.% nitrogen range. The maximum T_c of 4.85 K occurred in a compound close to the phase boundary between $\beta-W$ and W_2N. (auth)

23193 ION BACKSCATTERING STUDY OF TANTALUM NITRIDE THIN FILM RESISTORS. Langley, R.A.; Sharp, D.J. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 12: No. 1, 155-159 (Jan 1975).

Ion backscattering has been used to characterize thin film tantalum nitride resistors with thicknesses in the range 500-600 Å. The amount of surface oxide, the nitrogen content, its depth distribution, the amount of argon-sputtering gas incorporated into the film, and its depth distribution, are measured directly by the technique. The films were prepared by diode sputtering in a pilot line facility. All sputtering parameters were held constant except for the N_2 flowrate, which was varied so as to change the nitrogen concentration in the films. The electrical properties of the films were characterized by measurements of the sheet resistance and the differential Seebeck voltage. Aluminum oxide substrates were used for the electrical measurements and beryllium substrates with thin oxide layers were used for the backscattering compositional analysis. As the N concentration decreased below the stoichiometric composition Ta_2N to the composition $Ta_2N_{0.5}$, the resistivity was found to decrease linearly by 25% and the differential Seebeck voltage to increase linearly by 90%. (auth)

23194 MICROSPHERES OF URANIA AND OTHER MATERIALS. Fitch, F. T.; Braun, A. B. (to W. R. Grace and Co.). US Patent 3,862,908. 28 Jan 1975. Filed date 3 May 1967. 10p.

Oxide sols can be used to prepare microspheres, particularly for nuclear fuel elements. The microspheres can be prepared from various colloidal materials that sinter to suitable ceramics, e.g., Al_2O_3, ZrO_2, BeO, actinide oxides, rare earth oxides, etc. The colloidal constituents contribute to improved properties on account of the strong sinterability. Examples of the invention is given using UO_2, Y_2O_3, ZrO_2, and ThO_2. (DLC)

23195 METHOD FOR MANUFACTURING COMPOSITE ARTICLES CONTAINING BORON CARBIDE. Moss, J. R. (to Coors Porcelain Co.). US Patent 3,857,744. 31 Dec 1974. Filed date 19 Jan 1970. 4p.

A composite silicon impregnated boron carbide body bonded to a backing material for said body is manufactured by forming a boron carbide powder compact of the desired shape and size, coating a surface of the compact with boron nitride powder, impregnating the boron nitride coated boron carbide powder compact with silicon, removing from the surface of said body at least most of the boron nitride layer and any silicon deposited thereon, and then bonding the silicon impregnated boron carbide body to the organic resin backing material. (Official Gazette)

23196 STUDY OF THE SYNTHESIS KINETICS AND STRUCTURE OF SULFIDE COATINGS ON NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN. Koval'chenko, M. S.; Sychev, V. V.; Yurchenko, D. Z.; Tkachenko, Yu. G. Izv. Akad. Nauk SSSR, Metal.; No. 5, 221-225(1974). (In Russian).

A study is made of the kinetics of sulfiding metals of groups V and VI of the periodic table. Estimates are given for the activation energy and diffusion coefficients of the components (metal, chalcogen). It is shown that during film growth on all the metals except for molybdenum, the diffusion of metal through the chalcogenide film is dominant. An x-ray study of the structure of the sulfide coatings on the transition metals is presented. (SJR)

23197 DEVELOPMENT OF THE SURFACE IN THE COURSE OF THE REDUCTION OF TUNGSTEN TRIOXIDE. Uvarova, I. V. Izv. Akad. Nauk SSSR, Metal.; No. 5, 36-38(1974). (In Russian).

The specific surface of tungsten trioxide obtained by decomposing ammonium paratungstate does not depend on the specific surface of the initial product. In the course of reducing tungsten trioxide a change in the specific surface of the powder takes place. An oxide of the composition W_3O possesses the maximum surface. A finely dispersed powder of tungsten is obtained during the low-temperature reduction of tungsten trioxide, by dry hydrogen and on rapid removal of the reaction products-water vapor. (SJR)

23198 OXIDE AND SULPHIDE INCLUSIONS OF CERIUM AND LANTHANUM IN IRON. Roshchin, V. E.; Povolotskii, D. Ya.; Katkov, A. V.; Rechkalova, A. V.; Stanovnova, L. B. Izv. Akad. Nauk SSSR, Metal.; No. 5, 17-23(1974). (In Russian).

On reacting cerium and lanthanum with oxygen and sulfur dissolved in liquid iron, rather pure oxide and sulfide phases of cerium and lanthanum are obtained. A study was made on the properties of inclusions formed by the oxides: CeO_2, Ce_2O_3, Ce_2S_3, CeS, La_2O_3, LaS_2, LaS, $CeAlO_3$, $LaALO_3$, and also by the solid solutions Fe–O–R and Fe–S–R. A determination was made of the optical constants of the inclusions $CeAlO_3$, $LaAlO_3$, LaS, and Ce_2S_2. More accurate values were obtained of the refractive indexes of La_2O_3, Ce_2O_3 and CeO_2. (SJR)

23199 CRYSTAL STRUCTURE OF GdO_2 AND EuO_2. Imamov, R.M.; Ragimli, N.A.; Semiletov, S.A. (Institute of Crystallography, Academy of Sciences of the USSR). Sov. Phys.–Crystallogr. 19: No. 4, 466-467 (Jan 1975).

The existence of previously unknown tetragonal GdO_2 and EuO_2 phases in the Gd–O and Eu–O systems was established by electron–diffraction investigation, and their structures were interpreted. The interatomic separations and forms of the coordination polyhedra of GdO_2 and EuO_2 approximate to a structure of the PbFCl type. (auth)

23200 THERMODYNAMIC PROPERTIES OF NONSTOICHIOMETRIC VANADIUM DIOXIDE AT HIGH TEMPERATURES AND 298.15°K. Balabaeva, R. F.; Vasil'eva, I. A.; Gerasimov, Ya. I. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 217: No. 5, 1103-1106(1 Aug 1974). (In Russian).

The dependence of $\overline{\Delta G^0_{O_2}}$ (x), $\overline{\Delta H^0_{O_2}}$ (x), and $\overline{\Delta S^0_{O_2}}$ (x) of the oxides VO_x was determined in the VO_2 region in the temperature interval from 1100 to 1325°K. The temperature boundaries of y_1 and y_2 were determined in the region VO_{2-y_1} to VO_{2+y_2}. ΔG^0_f, ΔH^0_f, and ΔS^0_f were determined in the VO_2 region at 1300° and 298.15°K. (JSR)

23201 PROCESS FOR PREPARING SINTERED URANIUM DIOXIDE NUCLEAR FUEL. Carter, R. E. (to General Electric Co.). Canadian Patent 960,024. 31 Dec 1974. vp.

The process described comprises sintering uranium dioxide to the desired density at a temperature not in excess of about 1500°C in a chemically controlled gas atmosphere comprised of a predetermined ratio of at least two gases which in equilibrium provide an oxygen partial pressure sufficient to maintain the uranium dioxide composition at an O/U ratio of at least 2.005 at the sintering temperature. (auth)

23202 STABILITY OF CATHODES MADE OF LANTHANUM HEXABORIDE USED IN WELDING ELECTRON GUNS. Nazarenko, O. K.; Lokshin, V. E.; Akop'yants, K. S. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki); Paderno, Yu. B.; Pilyankevich, A. N.; Nerus, M. A.; Paderno, V. N. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Avtomat. Svarka; No. 6, 50-52 (Jun 1974). (In Russian).

For English translation see the journal Autom. Weld.

A study was made of the mutual relation of operating stability in electron-beam cathodes made of lanthanum hexaboride with the structure and mode of preparation. The operating stability of the cathodes increases with an improvement in the structure of the material, in particular, with an improvement in the intergranular boundaries and with an increase in the degree of homogeneity of the cathode piece. The structure of the cathode elements made of lanthanum hexaboride is optimal in making the cathodes by induction melting with a simultaneous purification zone, or in sintering by hot pressing with a subsequent, high-temperature annealing. (tr-auth)

23203 SINTERING OF BERYLLIUM OXIDE: INFLUENCE OF MINOR ADDITIONS ON DENSIFICATION AND MICROSTRUCTURAL DEVELOPMENT. Bhat, R.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). Trans. Indian Ceram. Soc.; 32: No. 1, 1-10(Jan 1973).

The influence of 0.01 to 5 wt % additions of MgO, TiO_2 and Fe_2O_3 on the sintering behaviour and grain development of beryllium oxide was studied at temperatures between 1100° and 1500°C in vacuum and in air. Significant effect was noticed on the sintering behaviour and grain growth. Both densification and grain growth attained a maxima with MgO and TiO_2 additions, the optimum value being around 1%. With Fe_2O_3 both the densification and grain growth seem to be directly related to the amount of additions. (auth)

23204 CALCULATION OF ELECTRON SPECTRA OF TRANSITION METAL COMPOUNDS BY THE GO-LCAO METHOD. Goryachev, Yu. M.; Kovenskaya, B. A.; Samsonov, G. V. (Inst. of the Problems of the Study of Materials, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 86-92(1974). (In Russian).

The basic assumptions in the calculation of the electron spectra of crystalline materials by the GO-LCAO method were discussed. Specific data on the calculation of the electron spectra of diborides of Ti, Zr, Hf, V, Nb, Ta, and Cr were reported. The calculation results were used for the evaluation of a series of parameters of the electron structure: dissociation energy, size of the charge of the atoms, degree of filling of the individual electron states, statistical weight of the atoms with stable electron configurations. A relation was established between the regularities of the change of the properties of the compounds examined and the population of the atomic orbitals up to the state of stable sp-configuration of the B atom and the d-configuration of the metal atoms. (tr-auth)

23205 THERMODYNAMIC INVESTIGATION OF THE SCANDIUM TUNGSTATE Sc_6WO_{12} AT HIGH TEMPERATURES AND ITS X-RAY PARAMETERS. Chentsov, V. N.; Levitskii, V. A.; Trunov, V. K. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 217: No. 4, 884-887(1974). (In Russian).

The emf and x-ray parameters of scandium tungstate coexisting at high temperatures with scandium oxide were measured and the values obtained were tabulated. The values obtained were used to calculate the thermodynamic properties. (JSR)

23206 FORM OF CARBIDE CRYSTALLIZATION IN MOLYBDENUM. Savitskii, E. M.; Burkhanov, G. S.; Kirillova, V. M.; Ottenberg, E. V. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 217: No. 1, 77-78(1974). (In Russian).

A scanning electron microscope was used to study the form and location of carbide inclusions in electron-beam fused Mo with 0.08 wt. % C and arc-fused Mo with 0.1 and 0.01 wt. % C. From the phase diagram of Mo–C, closest to the Mo corner, the carbide has the stoichiometric formula Mo_2C and is formed in eutectic reactions at 2170°C. During crystallization in unequilibrium conditions the dicarbide in the Mo matrix is located both within the crystal and at its boundaries. With decrease of the C content the carbides are found only at the grain boundaries. Most of the carbide inclusions have a dendrite form. (JSR)

Metals and Alloys

Refer also to abstract 23156.

23207 (COO-1198-1128) SOLUBILITY OF HYDROGEN IN TANTALUM. Lecocq, P. (Illinois Univ., Urbana (USA). Dept. of Mining, Metallurgy, and Petroleum Engineering). Oct 1974. Contract AT(11-1)-1198. 84p. Dep. NTIS $7.25.

Solubility of hydrogen in tantalum in equilibrium with the hydride was measured by a resistometric technique. Composition ranged from 0.5 to 10 at. % H. The solvus line is given by the equation $\ln C = 6.0 - 2150/RT$. The heat of solution is 2150 cal/mole. Ternary Ta–O–H alloys (containing 0.6 at. % O in solid solution) had a solvus line for hydrogen no different from the Ta–H binary system. The Ta–D solvus is nearly the same as that for hydrogen in tantalum. Thermal cycling through the solvus temperature increases the "apparent" solvus temperature slightly. Thermal hysteresis occurs on cooling and heating, and is explained in terms of mechanical constraint of the matrix on the nucleation and growth of the precipitate. Growth of the hydrides depends on long-range diffusion. Trapping of H by O is believed to be responsible for low diffusivities and the long times needed to achieve equilibrium. The contribution of hydrogen and deuterium in solid solution to the residual resistivity of tantalum is 0.51 $\mu\Omega$ cm per at. %, a value lower than that for either V or Nb. (21 fig) (DLC)

23208 (ORO-4311-3) QUANTITATIVE ANALYSIS OF SOLUTE SEGREGATION IN ALLOYS BY TRANSMISSION ELECTRON MICROSCOPY. Progress Report, September 1, 1973–August 31, 1974. Hren, J. J.; Hartley, C. S.; Cooper, W. D.; Headley, T. J.; Warren, J. B. (Florida Univ., Gainesville (USA). Engineering and Industrial Experiment Station). Sep 1974. Contract AT(40-1)-4311. 270p. Dep. NTIS $16.50.

Research was conducted to establish the mechanism for repeated nucleation of θ' on climbing dislocations in Al–Cu (4 to 0.5% Cu). Electron microscopy was used to image the precipitates. The dislocations are generated and climb during quenching by annihilation

of the quenched-in vacancies, and the θ′ precipitates nucleate in the passing stress fields of the climbing dislocations. Computer simulations were carried out of heterogeneous nucleation of Cu and Ni in Si and of γ′ phase on stacking faults formed during aging of IN-901. Work on the generalized computer simulation program is also reported. (DLC)

23209 (PWAC-1020) PWAC-1020 ADVANCED MATERIALS PROGRAM FOR MARCH AND APRIL 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 May 1965. Contract AT(30-1)-2789. 77p. Dep. NTIS $7.00.

Declassified 29 Sep 1965.

Results of research are summarized on reactor metals and alloys, fuels and ceramic materials, alkali metals, surface chemistry, and space radiators. (JRD)

23210 (PWAC-1021) PWAC-1021 ADVANCED MATERIALS PROGRAM FOR MAY AND JUNE 1965. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 31 Aug 1965. Contract AT(30-1)-2789. 67p. Dep. NTIS $6.50.

Declassified 20 Sep 1973.

Research results are presented on metallurgy of Nb–Zr–C alloys, low density structural alloys, chemical properties of fuels, properties of alkali metals, and space radiator development. (JRD)

23211 (RN-PA-0024(Vol.1)) MATERIAL PRESENTED TO SNPO IN SHIELDING TRADE STUDY REVIEW. Warman, E. A.; Koebberling, K. O. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 23 Oct 1969. 86p. Dep. NTIS $7.50.

Data and drawings associated with Nerva Reactor shielding trade study are presented. Information is included on radiation doses, shielding weight, weight reduction concepts, and reactor component materials. (JRD)

23212 (TID/SNA-149) MANUAL OF MATERIALS DATA RELEASE MEMORANDA. Supplement I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1971. 58p. Dep. NTIS $6.00.

Property data are presented on Nerva Reactor materials including Ti-base alloys, alloy A-286, and Ag-Carb-101 composite material. (JRD)

23213 (TID/SNA-374) NERVA MATERIALS DEVELOPMENTS. Third Quarter, Contract Year 1970 (April, May, and June). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jul 1970. 214p. Dep. NTIS $13.75.

Materials and processes development activities for the third quarter of Contract Year 1970 are reported. Topics include: (1) the detrimental effects of high-pressure, pure gaseous hydrogen upon Alloy 718 and Ti–5Al–2.5Sn (ELI) throughout the NERVA operating temperature range; (2) analysis of data for development of design allowables, including fatigue properties of Alloy 718, tensile properties of AA 7039-T63, 347 stainless steel, Al alloy AA 6061-T6, A-286 bolts, coefficients of friction for several sliding material combinations, and thermal conductivity of 347 stainless steel; and (3) evaluation of prepreg and impregnation materials for optimization of fibrous-graphite properties. Cryogenic fracture-toughness testing of Alloy 718 for turbopump applications, as well as tensile testing of AA 7039-T63 at 200 and 300°F, is described. Other activities include the application oriented trade studies, including selection of prime materials for the actuator gear, and equipment evaluation for line welding. Preliminary assessment was made of potential thermal coatings for pressure-vessel application, and a review was conducted of prospective shield materials. (auth)

23214 (TID/SNA-631) NERVA MATERIALS DEVELOPMENTS, SECOND QUARTER, CONTRACT YEAR 1970 (JANUARY, FEBRUARY, AND MARCH). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 323p. Dep. NTIS $19.25.

Material and processes development activities for the second quarter of Contract Year 1970 are reported. Topics include: (1) the detrimental effects of high-pressure, pure gaseous hydrogen on mechanical properties of alloy 718 and Ti–5Al–2.5Sn (ELI); (2) development of statistical design allowables for nine alloys, including AGCarb-101 graphite composite, AA-6061 forging, Ti–6Al–4V sheet, Alloy-718 forging and sheet, AA-5083 sheet, AA-7075-T73 forging, AA-7039-T63 forging, and A-286 forgings; (3) specimen development for irradiation testing of bolt materials; (4) measurement of Inconel 718 Young's modulus and modulus of rigidity by dynamic means for Poisson's ratio computations; and (5) development of fibrous-graphite woven fabrics and integration to optimize interlaminar properties. Liquid hydrogen anisotropic fracture toughness studies of Ti–5Al–2.5Sn (ELI) and Alloy-718 forgings and critical specimen thickness of AA-7039-T63 forgings for valid ambient and –320°F liquid nitrogen K_{IC} fracture toughness values are also described. A diagnosis of anomalies associated with triple-braze 347-stainless-steel tensile properties, as well as a general review of shield material properties, are also included. (auth)

23215 (TID/SNA-679) MATERIALS REVIEW, 21-22 SEPTEMBER 1971. Redfield, T. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 122p. Dep. NTIS $9.25.

Plans and specifications for testing Nerva reactor materials are summarized in tabular and graphic forms. Information is included on Inconel 718, stainless steel 347, Ti-base alloys, alloy A-286, graphite, Al-base alloys, Hastelloy x, polymers, steels, stainless steel 440, radiation testing Be-base alloys, and cryogenic testing. (JRD)

23216 (TID/SNW-6) CATEGORY-C: MATERIALS DATA NUCLEAR SUBSYSTEM, E-105 APPENDIX. Volume III. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 311p. Dep. NTIS $18.75.

Property data on graphite, stainless steels, pyrofoil, Al-base alloys, ZrC, ZrO_2, Pb, Fe, steels, Hitron, and Durok. (JRD)

23217 (TID/SNW-7) CATEGORY-C: MATERIALS DATA NUCLEAR SUBSYSTEM E-105 APPENDIX. Volume II. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 384p. Dep. NTIS $22.25.

Property data are presented on NbC–graphite composites, graphite, bath shielding materials, and 304 stainless steel. (JRD)

23218 (TID/SNW-14) CATEGORY-C: MATERIALS DATA NUCLEAR SUBSYSTEM, E-105 APPENDIX. Volume I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 260p. Dep. NTIS $16.00.

Property data are presented on Nerva Reactor materials including NbC–graphite composites, graphite shielding materials, and 304 stainless steel. (JRD)

23219 BEHAVIOR OF VANADIUM IN THE SYSTEM: CONVERTER SLAG-CARBON REDUCTANT AT 1100 TO 1500°C. Tsikarev, V. G.; Pastukhov, A. I.; Popel, S. I. Tr. Ural. Nauch.-Issled. Inst. Chern. Metal.; 16: 18-23(1972). (In Russian).

Structure changes of the phase components of converter V slag during its reaction with C at 1100 to 1500°C were studied to disclose the successive stages in the transformation of the V spinel. The R_2O_3 phase is composed mainly of the oxides of V and Ti. The rate of reduction of V from this phase by the C of liquid cast iron is much greater than the rate obtained from a silicate melt. To lessen the completeness of V reduction it is proposed to use liquefiers which form a melt having a low solubility for the V-containing phase and which give an earlier transfer of V from the original spinels into the less soluble R_2O_3 phase. The process will also prevent the oxidation of this phase, because the more oxidized form of V has a greater solubility in the silicate melt and an increased capillary activity. (Ref. Zh.)

23220 SPLAVY REDKIKH METALLOV S OSOBYMI FIZICHESKIMI SVOYSTVAMI. (Alloys of Rare Metals With Special Physical Properties). Moscow; Izdatel'stvo Nauka (1974). 216p.

Experimental and theoretical material is presented on problems of the development and investigation of new superconducting, high-melting alloys and alloys based on noble and rare metals. Problems of the creation of new alloys with special physical properties are analyzed. Individual articles, 36 in number, deal with methods of calculating alloys with given properties and with the mathematical planning of the experiment. (JPRS)

23221 Fe–Mo–C–[Cr] SINTERED ALLOYS FOR VALVE SEATS. Iwata, T.; Sakamoto, K.; Nawata, T.; Endo, H.; Nakano, M.; Murayama, H. (to Mitsubishi Jidosha Kogyo Kabushiki Kaisha and Mitsubishi Kinzoku Kogyko Kabushiki Kaisha). US Patent 3,856,478. 24 Dec 1974. Priority date 22 Dec 1971, Japan.. 8p.

Described are ferrous sintered alloys adapted for use as valve seats in internal combustion engines resistive to wear and intermetallic impact wear from the heated valve associated therewith, the alloys composed essentially of from 0.4–2.0% carbon, 2–10% molybdenum, optionally containing 0.5–5.2% chromium, the balance being iron plus minor impurities are disclosed. The valve seats made of the novel sintered alloys are particularly suited for engines burning lead-free gasoline or engines using LPG as the fuel. (Official Gazette)

Corrosion and Erosion

Refer also to abstracts 22409, 24607, and 24942.

23222 (AD-784932) HOT CORROSION OF NICKEL-BASE ALLOYS CONTAINING ALUMINIUM AND MOLYBDENUM. Interim

Scientific Report No. 2, 15 May 1973–14 May 1974. Stringer, J.; El-Dahshan, M. E.; Whittle, D. P. (Liverpool Univ. (UK). Dept. of Metallurgy and Materials Science). 30 May 1974. 31p. (EOARD-TR-75-5). NTIS $4.75.

The effects of pre-sulfidation in H_2–10% H_2S mixtures, where the sulfur activity is sufficient to form nickel and chromium sulfides, on the oxidation behavior of a series of Ni–Cr, Ni–Cr–Al, Ni–Cr–Mo and Ni–Cr–Al–Mo alloys was investigated. In binary Ni–15Cr alloys, the presence of dispersed chromium sulfides in the alloy preclude the formation of a continuous Cr_2O_3 layer. The presence of molybdenum and to a lesser extent aluminum in the alloy increases the extent of attack after pre-sulfidation, particularly the depth of penetration of internal sulfides. Neither element is particularly deleterious under direct oxidation conditions, at least in flowing atmospheres. The technique of a brief pre-sulfidation treatment followed by oxidation is able to produce corrosion morphologies strikingly similar to those observed in practical hot corrosion conditions and it seems probable that the role of sulfur has been underestimated in recent mechanistic investigations. (auth)

23223 (AD-785249) LOAD AND ENVIRONMENT INTERACTIONS IN FATIGUE CRACK GROWTH. Technical Report Presented at the Conference on the Prospects of Advanced Fracture Mechanics Held at Delft (Netherlands) on 24-28 June 1974. Shih, T. T.; Wei, R. P. (Lehigh Univ., Bethlehem, Pa. (USA)). May 1974. Contract N00014-67-A-0370-0008. 26p. (IFSM-74-61). NTIS $3.25.

The effects of environment on delay and on fatigue crack growth under programmed loading were examined for a mill annealed Ti–6Al–4V alloy. Test environments included dehumidified argon, air (with 30 to 60% relative humidity), distilled water, and 3.5% NaCl solution. The effects of load sequence and block size on fatigue under programmed loads were investigated also. Experimental results show that the mildly aggressive environments (atmospheric moisture and distilled water) have little effect on delay. Salt solution, on the other hand, has a significant effect on delay and on crack growth under programmed loading; the effect on delay being dependent on frequency or hold-time. Both load sequence and block size can significantly alter fatigue life under programmed loading. The need for further fundamental understanding or load and environment interactions in fatigue is discussed. (GRA)

23224 (AD-785261) MODIFICATION AND CONTROL OF OXIDE STRUCTURES ON METALS AND ALLOYS (PHASE IV). Final Report, 2 March 1973–2 March 1974. Svedberg, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1974. Contract N62269-73-C-0361; N00019-70-C-0148. 161p. (WANL-M-FR-74-003). NTIS $5.00.

Nb–Co–Al and Nb–Fe–Al base alloys have been studied to determine the effects of composition both elemental and constituent (i.e., intermetallic alloy compounds used to make alloys) on the oxides formed during 1200°C oxidation in air. Alloys were formed by both pressing and sintering of intermetallic compounds and elemental powders and by arc melting alloy buttons from intermetallic compounds and elements in powder form. Oxidation kinetics have been measured, and the oxides formed have been examined by x-ray diffraction techniques. In addition, Y and Y_2O_3 additions were made to several alloys to evaluate the effects of rare earth additions on the oxide structure. In addition to the oxidation kinetics and oxide structure correlation, metallographic techniques were used to evaluate the depth of penetration of oxygen into the various alloys. This study confirmed that rutile type oxides such as $NbAlO_4$, $NbFeO_4$, and $NbCrO_4$ are responsible for improved oxidation performance. Parabolic rate constants were measured for these alloys. (GRA)

23225 (N-74-32017) COATINGS FOR DIRECTIONAL EUTECTICS. Final Report, 27 March–27 December 1973. Jackson, M. R.; Rairden, J. R.; Hampton, L. V. (General Electric Co., Schenectady, N. Y. (USA)). Jan 1974. Contract NAS3-16793. 101p. (NASA-CR-134665; SRD-74-047). NTIS $8.25.

Coating compositions were evaluated for oxidation protection of directionally solidified composite alloy NiTaC-13. These coatings included three NiCrAlY compositions (30-5-1, 25-10-1 and 20-15-1), two FeCrAlY compositions (30-5-1 and 25-10-1), a CoCrAlY composition (25-10-1), and one duplex coating, Ni–35Cr + Al. Duplicate pin samples of each composition were evaluated using two cyclic furnace oxidation tests of 100 hours at 871°C and 500 hours at 1093°C. The two best coatings were Ni–20Cr–15Al–1Y and Ni–35Cr + Al. The two preferred coatings were deposited on pins and were evaluated in detail in .05 Mach cyclic burner rig oxidation to 1093°C. The NiCrAlY coating was protective after 830 hours of cycling, while the duplex coating withstood 630 hours. Test bars were coated and cycled for up to 500 hours. Tensile tests indicated no effect of coatings on strength. In 871°C air stress rupture, a degradation was observed for coated relative to bare material. The cycled NiCrAlY coating offered excellent protection with properties superior to the bare cycled NiTaC-13 in 1093°C air stress rupture. (auth)

23226 (RN-DR-0144) STUDY OF SCALE FORMATION IN COOLANT TUBES. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1968. 28p. Dep. NTIS $4.50.

Three types of water were investigated: (1) raw water from a Nevada Test Site well, (2) the same water softened with a Zeolite softener, and (3) the same well water after it had been demineralized, treated with a corrosion inhibitor, and stored. The demineralized water had a slightly higher mineral content than the demineralizer effluent because of the inhibitor present and will subsequently be referred to as "tank" water. In addition, a very hard water from Davis, California, and a mixture of this water with raw water from the Nevada Test Site were used to afford a wider range of water qualities for study. The program comprised two phases: one to study scale formation due to boiling and one to study scale formation due to droplet evaporation. In general, the test program indicated the greatest danger of scale formation occurs when water is allowed to stand and evaporate within the coolant tubes. Virtually no scale was formed by the tank water after 50 wet-to-dry cycles. When the raw well water was used, approximately 0.5 mil of scale was formed; when softened water was used, a 0.25-mil scale was formed for the same number of cycles. The rate of deposition appeared to be linear with time. Also, the deposit was not removed when a sample was soaked for 120-hr in the low-mineral-content tank water. Scale formation was found to be predictable as a function of the Langelier saturation index for water. When the Langelier index was positive, scale was formed on flat plates immersed in boiling water. The scale that formed varied from about 0.9 mil for an index of +1.6 to 0.3 mil for an index of −2.93. For negative index values, the scaling appeared as widely scattered crystals on the metal surfaces. (auth)

23227 THE EFFECTS OF ENVIRONMENT, ORIENTATION AND STRENGTH LEVEL ON THE STRESS CORROSION BEHAVIOR OF U–0.75 wt % Ti. Magnani, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). J. Nucl. Mater.; 54: No. 1, 108-116(Nov 1974).

The effects of the environment, specimen orientation and the alloy strength level on the susceptibility of U–0.75 wt % Ti to stress corrosion crack propagation were determined. The data show that water (H_2) is the species responsible for cracking and the Cl^- concentration has little effect on the cracking behavior. The orientation of extruded specimens had little effect on the cracking behavior. The data also show that as the strength level of the alloy increases due to varying the aging treatment the threshold stress intensity for stress corrosion crack propagation decreases linearly. (auth)

23228 SURFACE CLEANLINESS OF 316 L + N STAINLESS STEEL STUDIES BY SIMS AND AES. Mathewson, A. G. (European Organization for Nuclear Research, Geneva). Vacuum; 24: No. 10, 505-509(Oct 1974).

Some cleaning methods for 316 L + N stainless steel including solvent cleaning, high temperature treatment in vacuo, and gas discharge cleaning were studied by SIMS and AES with a view to providing a clean vacuum chamber surface with low gas desorption under ion bombardment. After solvent cleaning, the main surface contaminant was found to be C and its associated compounds. Laboratory investigations on small samples of stainless steel showed that clean surfaces could be obtained by heating in vacuo to 800°C followed by exposure to air and by argon or argon/10% oxygen discharge cleaning. Due to a cross contamination within the vacuum system, the 800°C treated chamber gave positive desorption coefficients under ion bombardment. The pure argon discharge cleaned chambers proved stable, giving negative desorption coefficients up to 2200-eV ion energy even after several weeks storage between discharge treatment and installation. (auth)

23229 KINETICS ON THE OXIDATION OF MOLYBDENUM IN AIR AT 700 TO 760°C. Braverman, I. B.; Rakov, E. G.; Khazhinskii, M. Yu. Zh. Neorg. Khim.; 19: No. 11, 2949-2953(Nov 1974). (In Russian).

An equation is derived for evaporation of an oxide from a compact, spherical oxidized metal surface which decreases with time. By a gravimetric method which registers the change in sample mass and mass of volatile products a study is carried out on the oxidation of Mo samples in air, and it is proposed that the oxidation is limited by the rate of volatilization of MoO_3. (SJR)

23230 CARBURIZATION OF AUSTENITIC AND FERRITIC ALLOYS IN CARBON-SATURATED SODIUM AT 916 K. Gwyther,

J. R.; Hobdell, M. R.; Hooper, A. J. (Central Electricity Generating Board, Berkeley, Eng.). Met. Tech.; 1: No. 9, 406-411 (Sep 1974).

Relation between sodium carbon activity and the carbide composition and microstructure of structural and cladding steels is of particular importance to FBRs. Carburization could be approached in a reactor where adventitious ingress of carbonaceous material is possible. The extent and nature of carbide phases produced were established by metallographic and x-ray techniques; the carbides $(Fe,Cr)_7C_3$ and $(Fe,Cr)_{23}C_6$ with a range of Fe/Cr ratios were identified in austenitic steels containing 18 wt % Cr, and the carbide $(Fe,Cr)_3C$ was exclusively found in carburized ferritic steels containing 2¼ and 9 wt % Cr. An electrochemical carbon cell was used to measure the sodium carbon activity. (auth)

23231 SYSTEM FOR DEPOSITION AND HYDRIDING OF THIN METALLIC FILMS WITHOUT AIR EXPOSURE. Eichman, C.C.; Comeau, J.L.; Rinehuls, K.R. (General Electric Company, St. Petersburg, Florida 33733). J. Vac. Sci. Technol. 12: No. 1, 410-413 (Jan 1975).

This completely self-contained system provides capability to deposit erbium thin films on a substrate and to hydride the films without exposure to air. Precise controls are provided for cold crucible electron beam deposition of the erbium, for monitoring the film thickness during deposition, and for controlling the film bakeout temperature. A mechanical device transfers the deposited substrates to the hydriding chamber without exposure to air. The system is capable of analyzing gases within the system during various phases of processing to determine if outgassing is complete, to monitor for vacuum leaks and for health physics control. A major advantage is that the hydriding chamber can be vacuum baked and gas processed with hydriding gas before the erbium-deposited substrates are transferred into the chamber. (auth)

23232 INCORPORATION OF FOREIGN IONS IN ANODIC TANTALUM OXIDE LAYERS. Muenz, W. D. (Siemens A. G., Muenchen (F. R. Germany). Zentrallaboratorien fuer Nachrichtentechnik); Guenzel, E. (Siemens A. G., Muenchen (F. R. Germany). Grundlagenentwicklung fuer Bauelemente); Woerl, H. (Siemens A. G., Muenchen (F. R. Germany). Forschungslaboratorium). Metall; 28: No. 6, 592-596(Jun 1974). (In German).

9 figs.; 8 refs.

Investigations with the radionuclide ^{51}Cr as tracer showed that in the anodic oxidation of tantalum in chromic acid, contrary to the forming in phosphoric acid, no anionic components of the electrolyte are incorporated in the oxide layer. The dependence of phosphate incorporation in phosphoric acid on the forming voltage, forming current density, concentration of the electrolyte and on the forming temperature could be confirmed by using the radionuclide ^{32}P even over an extended range of the forming parameter. In addition, it was found that the concentration of the incorporated phosphate remains unchanged with increasing pH value of the phosphate electrolyte up to pH = 4. It decreases rapidly with further increase in pH and is negligibly small for pH > 11.5. The forming charge decreases with increasing phosphate incorporation independent of the varied forming parameter. (GE)

23233 METHOD FOR PROTECTING NIOBIUM AND TANTALUM AGAINST CORROSION BY HIGH TEMPERATURE OXYGEN. Shroff, A.; Delval, G. (to Institut National de la Propriete Industrielle). French Patent 2,180,583/A/. 21 Apr 1972. 7p. (In French).

The part to be protected is coated with iridium, osmium, rhenium, molybdenum or tungsten, obtained by the chemical decomposition of a halogen or carbon compound. When molybdenum or tungsten is used, this deposit is, in turn, protected by (1) an electrolytical deposit of gold, chromium or nickel; or (2) by forming a layer of molybdenum or tungsten di-silicide, depending on the temperature range for which the part is designed. (FR)

23234 ALLOYING ADDITIONS INFLUENCE ON CORROSION RESISTANCE OF NICKEL-MOLYBDENUM ALLOYS IN HYDROCHLORIC AND SULFURIC ACID SOLUTIONS. Akshentseva, A. P.; Shvarts, G. L.; Makarova, L. S.; Gerasimenko, G. I.; Kardonov, B. A. Khim. Prom. (Moscow); No. 2, 132-134(1974). (In Russian).

For English translation see the journal Sov. Chem. Ind.

Studies were carried out on industrial and laboratory alloys of the type Ni 70 Mo 27. It was established that alloys without vanadium (Ni-70 Mo-28 P and Ni-70 Mo-28 AP) have high resistance to edge and intercrystalline corrosion in sulfuric and hydrochloric media. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 22731 and 24693.

23235 (AD-785358) RESEARCH IN THE PRODUCTION OF RARE-EARTH-COBALT PERMANENT MAGNET MATERIAL BY SPUTTER DEPOSITION. Annual Technical Report, 15 February 1973-15 February 1974. Allen, R. P.; Dahlgren, S. D.; Arrowsmith, H. W.; Heinrich, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); Air Force Materials Lab., Wright-Patterson AFB, Ohio (USA)). May 1974. Contract F33615-73-C-5012. 46p. (AFML-TR-74-87). NTIS $3.25.

Research results are presented on sputter deposition of rare-earth-cobalt alloys; metallurgy of sputtered magnet material; magnetic property studies of sputtered amorphous alloys, RCo_5 alloys, R_2 (Co, Fe)17 alloys; oxygen control; preparation of $EuCo_5$; texture control; substrate-deposit compatibility; substrate removal studies; sputtering system design; and manufacturing process feasibility evaluation. (GRA)

23236 (AD-785910) BULK STRIP PRODUCTION OF AN AMORPHOUS Cu-Zr ALLOY BY PLASMA ARC SPRAYING. Giessen, B. C.; Madhava, N. M.; Murphy, R. J.; Ray, R.; Surrette, J. (Northeastern Univ., Boston, Mass. (USA)). Aug 1974. Contract N00014-68-A-0207-0006. 15p. (N-14-68-A-207-6-1). NTIS $3.25.

The background and design of a plasma spray unit with a rotary copper substrate and contained in an inert gas chamber is described. This unit is capable of producing amorphous alloys as strip of >30 mil thickness in bulk quantities at rates of 15 g/min, as demonstrated by the retention of amorphous $^{60}Cu^{40}Zr$. (auth)

23237 (GA-9500) CONTROL OF FLUORINE IN CVD TUNGSTEN. Chin, J.; Horsley, J.; Messick, C. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). 15 Aug 1969. Contract AT(04-3)-167. 30p. Dep. NTIS $4.50.

Declassified 5 Mar 1975.

The presence of fluorine in chemical vapor deposited tungsten is thought to be due to chemisorption of a reactant or product of the reacting gases, but might be due to inclusion of a solid fluoride or oxyfluoride. Attempts were made to determine what chemical species controlled the fluorine pickup. Deposition parameters were altered to favor various possible chemical reactions. The results showed that high fluorine content deposits occurred when the deposition temperature or H_2/WF_6 ratios were low. The oxygen level in the system affected the quantity of fluorine in the final tungsten deposit. Modest WF_6 depletion during deposition had no apparent effect on the fluorine content of the deposit. Results of the parametric studies suggest the cause of fluorine in tungsten to be the incomplete desorption of a tungsten fluoride, probably WF_6. Information gathered from parametric studies was used to set process conditions for thermionic diode emitter preparation. Mean fluorine contents and standard deviations were calculated for these emitters. The results showed the ability to control the fluorine content between 5 and 25 ppM. Activation analysis is proposed as a new method of measuring low fluorine contents in CVD tungsten. Comparison measurements of the fluorine contents of several vapor deposited tungsten samples were made by a standard fusion technique and activation analysis. These results are tabulated and discussed. (auth)

23238 PREPARATION AND CHARACTERIZATION OF HIGH-PURITY MOLYBDENUM SINGLE CRYSTALS. Capp, D. J. (Oxford Univ.); Evans, H. W.; Eyre, B. L. J. Less-Common Metals; 40: No. 1, 9-20(Mar 1975).

An investigation was made of the preparation of high-purity molybdenum single crystals by a combination of electron-beam zone-refining and thermal anneals. The changes in impurity levels were followed by means of resistivity ratio measurements and radiochemical analysis. Results show that the majority of the impurities are removed during zone-refining as a result of volatilization or outgassing. Two exceptions are: tungsten, which is not reduced to any significant extent and carbon, which is progressively transported to one end of the crystal during zone-refining. Carbon can be reduced to a low level (<4 at. ppM) subsequent to zone-refining by annealing at ~1600°C in an oxygen partial pressure of $\sim 6 \times 10^{-5}$ Torr, and the oxygen can then be reduced to a similar level by annealing under high vacuum ($<10^{-5}$ Torr) at ~1800°C. Results indicate that oxygen occupies substitutional sites when in solution in molybdenum. (7 figures) (auth)

23239 PURIFICATION OF YTTRIUM METAL BY ZONE REFINING AND FIELD FREEZING. Murphy, J. E.; Wong, M. M. (Dept. of Interior, Reno, NV). J. Less-Common Metals; 40: No. 1, 65-77(Mar 1975).

A study was made of the purification of yttrium metal by zone

refining and field freezing, using a floating molten zone to avoid contamination by the container material. The experiments were conducted under high vacuum to take advantage of the vaporization of volatile impurities. Travel rates of 5, 1, and 0.5 cm/h were used. Several metallic impurities such as Fe and Ni were removed by zone refining. Differences in results between zone refining and field freezing were small, and possible explanations are discussed. Vaporization contributed significantly to the purification process. Large single crystals of yttrium were produced by the techniques described. (auth)

23240 METHOD FOR MAKING THIN FILM TUNGSTEN–THORIUM ALLOY. Shang, D. C. T. (to International Business Machines Corp.). US Patent 3,859,176. 7 Jan 1975. Filed date 23 Feb 1973. 8p.

A thin film tungsten–thorium alloy is fabricated by a method utilizing an electroplating technique. In some applications, the W–Th alloy subsequently remains as a layer on the object on which it is deposited. In other applications, it is subsequently completely or partially removed from the object. Also, in applications where it is desired to have the W–Th alloy in a single crystal state, it is subsequently annealed. (Official Gazette)

23241 ZONE RECRYSTALLIZATION OF INDIUM. Bel'skii, A. A.; Nekrasova, E. A. Izv. Akad. Nauk SSSR, Metal.; No. 5, 46-50(1974). (In Russian).

With the use of silver as an impurity a study is carried out of the effect of the intensity of electromagnetic agitation of a melt on the efficiency of the zone recrystallization of indium and on the impurity distribution in a cross-section of the rod. The value of efficiency distribution coefficient of silver ($K_{eff} < 1$) decreases with an increase in the strength of the traveling electromagnetic field H. In a small interval of H values equal to 15000 to 20000 a/m this decrease is abrupt in character. Note is taken of the preferred enrichment in the lower part of the rod cross-section on carrying out the zone recrystallization of indium without electromagnetic agitation of the melt in the zone. On applying a traveling electromagnetic field the distribution of silver impurity in the cross-section of the rod is more homogeneous. (SJR)

23242 METHOD OF MAKING BERYLLIUM SHAPES FROM POWDER METAL. Velten, E. M.; Jagaciak, G. J.; Wambold, J. N.; Epstein, A. (to Kawecki Berylco Industries, Inc.). Canadian Patent 956,761. 29 Oct 1974.

The method comprises first pressing the beryllium or beryllium alloy shape either by isostatic pressing or conventional mechanical compacting methods at room temperature to 60 to 95% of theoretical density at 30,000 to 90,000 psi, and subsequently pressing and heating to final size and density between 1400 and 2150°F (preferably 1550 to 1900°F) and from 100 to 10,000 psi effective pressure on the compacted powder, preferably at 100 to 2500 psi. The second pressing of the shape is done with mechanical pressure simultaneously with the application of heat under vacuum or inert environment. (CA)

23243 JOINT PRESSING WELDING OF STAINLESS STEEL WITH A ZIRCONIUM ALLOY. Frolov, N. G.; Shilkov, Yu. B.; Rivkin, E. Yu.; Rodchenkov, B. S.; Bulygin, V. P. Svar. Proizv.; No. 5, 14-16(May 1974). (In Russian).

For English translation see the journal Weld. Prod.

Optimal parameters were determined for pressure bonding of stainless steel with zirconium alloy applicable to tube reducers with a diameter to 20 mm: temperature of 800 ± 25°C; elongation coefficient of 6, and matrix angle of 120°C. The bond which was developed possesses high values of strength, plasticity and resistance to corrosion-mechanical disruption, in connection with which it is possible to recommend this method of joining for use in reactor construction. (tr-auth)

23244 USE OF CONCENTRATED SOLAR RADIATION FOR WELDING OF METALS. Akhmedov, A. R.; Afanas'ev, I. V.; Smol'skij, G. V.; Filimonov, V. I.; Aminov, E. I.; Radzhabov, R. S. (AN Uzbekskoj SSR, Tashkent. Inst. Ehlektroniki). Svar. Proizv.; No. 2, 12-14(Feb 1974). (In Russian).

For English translation see the journal Weld. Prod.

A device was developed by means of which it is possible to weld metals by means of concentrated solar energy. An estimate is given for the energy parameters of the solar furnace. The technology was developed for the solar welding of stainless steel Kh18N10T having thicknesses of 1.5, 2 and 3 mm. The welding of large thicknesses is possible with the use of large-size concentrators. An analysis of the results showed that with the solar method of welding, in spite of the increase in grain size, the mechanical properties of welded articles are rather good (rupture strength is not less than 90% of the base metal strength, bending angle of 180°). It can be expected that improvements in welding technology and also in more effective measures of decreasing the grain size will result in even better mechanical properties of welded articles. It was established that welding of stainless steel Kh18N10T of the above thicknesses should be conducted in a heat-removal rig. (tr-auth)

23245 STUDY OF ELECTROPOLISHING PROCESS OF TANTALUM. Ippolitova, L. A.; Korovin, N. V. (Moskovskij Ehnergeticheskij Inst. (USSR)). Elektrokhimiya; 10: No. 4, 517-520(Apr 1974). (In Russian).

For English translation see the journal Sov. Electrochem.

This study advances the assumption that the leveling of a tantalum surface at a current density up to 100 ma/cm^2 is caused by a viscous, near-anode layer consisting of dissolution products. At a current density above 100 ma/cm^2 the polishing effect is connected with the formation of a passivating film on the anode. (tr-auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 22507, 23834, 24146, 24147, 24152, 24158, 24160, and 25023.

23246 (AD-773546) DEFORMATION AND SOLID SOLUTION STRENGTHENING OF BCC TITANIUM–VANADIUM ALLOYS. Annual Report, 1 June 1971–31 December 1973. Paton, N. E.; Williams, J. C. (Rockwell International Corp., Thousand Oaks, Calif. (USA). Science Center). Jan 1974. Contract N00014-71-C-0363. 31p. NTIS $3.25.

The influence of oxygen on the strength and deformation behavior of Ti–40V single crystals containing various amounts of oxygen has been examined. The flow stress has been analytically separated into a thermally activated component (τ^*) and an athermal component (τ_μ). It is shown that τ^* increases linearly with oxygen concentration (C), whereas τ_μ increases as C to the ½ power. Oxygen also reduces the tendency for planar slip by enhancing cross slip. The implications of these effects on the properties of bcc Ti alloys are discussed. (GRA)

23247 (AD-780915) MECHANICAL RESPONSE OF A POROUS URANIUM ALLOY. Final Report, December 1972–July 1973. Shipman, F. H.; Johnson, J. N.; Green, S. J. (Terra Tek, Inc., Salt Lake City, Utah (USA)). Apr 1974. Contract DAAG46-73-C-0094. 55p. (AMMRC-CTR-74-34). NTIS $3.75.

Experimental and theoretical results are presented for the mechanical response of a porous uranium alloy subject to quasi-static uniaxial strain and hydrostatic compression. Two states of porosity were studied; one very small (about 1%) and the other somewhat larger (about 13%). Experimental techniques previously employed on geological materials are used to obtain all principal stress and strain components. Also, longitudinal elastic wave speeds obtained by ultrasonic techniques are presented as a function of initial sample density. The stress-strain behavior of this material is porosity dependent and no distinct elastic limit or crushup strength is observed. An analytical model that considers both the mean normal stress and the deviatoric stress influence on the crushup process is developed for uniaxial-strain and hydrostatic loading conditions. (GRA)

23248 (AD-783328) GROWTH AND HARDENING OF ALKALI HALIDES FOR USE IN INFRARED LASER WINDOWS. Annual Report No. 2. Sibley, W. A.; Butler, C. T.; Hopkins, J. R.; Martin, J. J. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). 20 Apr 1974. Contract F19628-72-C-0306. 31p. (AFCRL-TR-74-0220). NTIS $3.25.

Several KCl crystals have been pulled from melts of reagent grade KCl, rap treated reagent grade KCl, and RCl/Cl_2 treated KCl. The OH^- concentrations and the 10.6 micrometers optical absorption of these crystals were evaluated. The results indicate that both the rap and HCl/Cl_2 treatments effectively remove OH^- and lower the 10.6 micrometers absorption. Radiation damage has been investigated as a supplementary mechanism for strengthening KCl-KBr alloys and polycrystalline KCl. The results show that the hardening due to the radiation damage is independent of the other mechanisms present. Hence, the total strength equals the radiation damage in the pure crystal plus the strength caused by either alloying or small grains. (GRA)

23249 (AD-783985) TUNGSTEN-REINFORCED OXIDATION-RESISTANT COLUMBIUM ALLOYS. Final Report, 20 February 1973–20 February 1974. Klein, M. J.; Metcalfe, A. G. (Solar, San Diego, Calif. (USA)). May 1974. Contract N622969-69-C-0218. 113p. (RDTR-1759-4). NTIS $4.50.

Optimization of the niobium alloy/tungsten composites has continued for general gas turbine application at 2000 to 2400°F. Major improvements were made in hot transverse strength, control of structural stability, izod and ballistic impact strength,

creep strength, hot corrosion at 2200°F, and thermal shock resistance. These improvements were accomplished at the expense of some loss of fail-safe life for severely damaged specimens. This composite system can be optimized for specific applications by adjustment of the matrix composition and selection of tungsten filaments with specific properties. (GRA)

23250 (AD-786471) EVALUATION OF ELASTOMERS, PLASTICS, COATINGS, AND METALS. Final Report, 1 February 1972–30 June 1974. Gerdeman, D. A.; Berner, W. E.; Petrak, G. J. (Dayton Univ., Ohio (USA). Research Inst.). Jun 1974. Contract F33615-72-C-1282. 313p. (UDRI-TR-74-04; AFML-TR-74-125). NTIS $9.25.

Results of investigations are presented on the mechanical properties of metals and on the evaluation of nonmetallic materials. The fracture and crack growth properties of the primary structural materials, HP 9Ni–4Co–20C steel, 2024–T851 aluminum, and Ti–6Al–4V titanium for the B-1 were studied. Other system support programs included the evaluation of landing gears fabricated from 7175-T736 and 7049-T73 and special tensile and elongation measurements of bolts. Also described are a computer program for analyzing crack growth data and studies of fatigue crack growth retardation and fatigue crack starter defects. The second section describes the evaluation of nonmetallic materials, principally elastomers, fuel tank sealants, fuel cell coatings, and the mechanical property, compatibility, and hydrolytic stability testing of exterior fuel cell foams and coatings. (GRA)

23251 (AD-786541) DIRECT IDENTIFICATION OF ATOMIC BINDING SITES ON A CRYSTAL. Graham, W. R.; Ehrlich, G. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). Jul 1974. Contract DAAB07-72-C-0259. 53p. (R-656; UILU-ENG-74-2222). NTIS $4.25.

The atomic resolution of the field ion microscope, in conjunction with its ability to remove and identify individual atomic layers, has been used to map unambiguously the unit cell of the (111) plane of tungsten and to determine directly the location of single tungsten atoms absorbed on this plane. Adatoms have been observed to occupy two binding sites only. The predominant site corresponds to a normal lattice position. The second site is of similar symmetry, in that the adatom is found between three first layer atoms; however, at this position the adatom is located above an atom in the second rather than the third lattice layer. The former site is favored energetically, but only by approximately ½ eV. All observations have been made at high fields, but it is shown from studies of migration and other effects that the binding sites identified in the field ion microscope are typical of a normal, field free environment. (GRA)

23252 (AD-786668) TRANSFORMATION CHARACTERISTICS OF QUATERNARY URANIUM-BASE ALLOYS. Final Report. Blake, D. E.; Hehemann, R. F. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). Jul 1974. Contract DAAG46-73-C-0130. 67p. (AMMRC-CTR-74-51). NTIS $4.25.

The transformation characteristics of quaternary uranium-base alloys containing small, equal amounts (K) of molybdenum, niobium, and zirconium with 0.5% wt titanium were examined by dilatometric, hardness, metallographic and x-ray diffraction techniques. Principal emphasis was placed on isothermal transformation of an alloy with K = 1.5%. Quench-ageing treatments of this alloy as well as isothermal transformation of an alloy with K = 0.75% were studied less extensively. (GRA)

23253 (AED-CONF-74-538-024) PEAK TEMPERATURE COOLING TIME (PTCT) DIAGRAM OF PRESSURE VESSEL STEELS ASME SA-508 cl.2 AND SA-533 gr.B cl.1. Klumpes, H. (Rotterdamse Droogdok Maatschappij N. V. (Netherlands)). 1974. 18p. INIS.

From 2nd international colloquium "welding in nuclear engineering"; Duesseldorf, F. R. Germany (23 Oct 1974).

Prediction of microstructure in heat-affected zones by means of peak-temperature cooling time diagrams is discussed; comparison between real and simulated heat-affected zones is made. (GE)

23254 (AGC-2512) INCIDENT REPORT, 30 MARCH 1963, MATERIALS TEST PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1963. 121p. Dep. NTIS $9.25.

Results are presented of an investigation into the cause of failure of a set of hydrogen dewars used for a materials test program. The history of the dewars is given and the events which occurred during the two and one half days which preceded the final decision to stop the test. Results of stress analyses of the dewar walls are presented, together with the results of hydrotest to failure of the residual walls of two of the dewars. A metallurgical examination was conducted on welds from two of the dewars. These investigations confirm that the primary cause of failures was stress-induced cracks in low quality welds. (auth)

23255 (LBL-3188) LOW FREQUENCY NOISE IN SUPERCONDUCTING Sn FILMS AT THE TRANSITION TEMPERATURE. Clarke, J.; Hsiang, T. Y. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-eng-48. 5p. (CONF-740957-31). Dep. NTIS $4.00.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

The noise power spectrum of tin films evaporated on glass substrates biased at the transition temperature were measured. The spectrum is close to 1/f between 0.1 and 1000 Hz. The noise is found to be correlated over a correlation length $(D/\pi f)^{\frac{1}{2}}$, where D is the diffusivity of tin film. Samples in which a thin layer of aluminum was predeposited before tin evaporation were also studied. The aluminum layer appears to greatly reduce the thermal boundary resistance between tin and the substrate. The amplitude of noise for such samples is greatly reduced below 10 Hz, where it it almost independent of frequency. These results are in accord with the thermal diffusion theory proposed by Clarke and Voss. They should have important implications on future construction of superconducting bolometers. (auth)

23256 (N-74-26027) CREEP BEHAVIOR OF TANTALUM ALLOY T-222 AT 1365 TO 1700 K. Titran, R. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jun 1974. 35p. (NASA-TN-D-7673; E-7790). NTIS $3.25.

High vacuum creep tests on the tantalum T-222 alloy at 0.42 to 0.52 T_m show that the major portion of the creep curves, up to at least 1% strain, can be best described by an increasing creep rate, with strain varying linearly with time. Correlation and extrapolation of the creep curves on the basis of increasing creep rates results in more accurate engineering design data than would use of approximated linear rates. Based on increasing creep rates, the stress for 1% strain in 10,000 hours for T-222 is about four times greater than for the Ta–10W alloy. Increasing the grain size results in increased creep strength. Thermal aging prior to testing caused precipitation of the hexagonal close packed $(Hf,Ta)_2C$, which initially increased creep strength. However, this dimetal carbide was converted during creep testing to fcc (Hf,Ta)C. (auth)

23257 (N-74-26030) ELEVATED TEMPERATURE DEFORMATION OF THORIA DISPERSED NICKEL–CHROMIUM. Annual Status Report, June 1974. Kane, R. D.; Ebert, L. J. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Jun 1974. 106p. (NASA-CR-138504). NTIS $8.50.

The deformation behavior of thoria nickel–chromium (TD–NiCr) was examined at 593 to 1260°C in tension and compression and at 1093°C in creep. Major emphasis was placed on: (1) the effects of the material and test related variables (grain size, temperature, stress and strain rate) on the deformation process; and (2) the evaluation of single-crystal TD–NiCr material produced by a directional recrystallization process. Elevated-temperature yield strength levels and creep activation enthalpies were found to increase with increasing grain size reaching maximum values for the single crystal TD-NiCr. Stress exponent of the steady state creep rate was also significantly higher for the single-crystal TD-NiCr as compared to that determined for the polycrystalline materials. The elevated temperature deformation of TD-NiCr was analyzed in terms of two concurrent, parallel processes; diffusion-controlled grain boundary sliding, and dislocation motion. (auth)

23258 (N-74-26364) EFFECT OF OUTDOOR EXPOSURE AT AMBIENT AND ELEVATED TEMPERATURES ON FATIGUE LIFE OF Ti–6Al–4V TITANIUM ALLOY SHEET IN THE ANNEALED AND THE SOLUTION TREATED AND AGED CONDITION. Phillips, E. P. (National Aeronautics and Space Administration, Langley Station, Va. (USA). Langley Research Center). Jun 1974. 24p. (NASA-TN-D-7540; L-9374). NTIS $3.00.

Specimens of Ti–6Al–4V titanium alloy sheet in the annealed and the solution-treated and aged heat-treatment condition were exposed outdoors at ambient and 560°K (550°F) temperatures to determine the effect of outdoor exposure on fatigue life. Effects of exposure were determined by comparing fatigue lives of exposed specimens to those of unexpected specimens. Two procedures for fatigue testing the exposed specimens were evaluated: (1) fatigue tests conducted outdoors by applying 1200 load cycles per week until failure occurred and (2) conventional fatigue tests (continuous cycling until failure occurred) conducted indoors after outdoor exposure under static load. The exposure period ranged from 9 to 28 months for the outdoor fatigue-test group and was 24 months for the static-load group. All fatigue tests were constant-amplitude bending of specimens containing a

drilled hole (stress concentration factor of 1.6). Results indicate that the fatigue lives of solution-treated and aged specimens were significantly reduced by the outdoor exposure at 560°K but not by the exposure at ambient temperature. Fatigue lives of the annealed specimens were essentially unaffected by the outdoor exposure at either temperature. The two test procedures—outdoor fatigue test and indoor fatigue test after outdoor exposure—led to the same conclusions about exposure effects. (auth)

23259 (N-74-31006) TDNiCr (Ni–20Cr–2ThO_2) FORGING STUDIES. Final Report. Filippi, A. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1974. 157p. (NASA-CR-134619; WANL-M-FR-74-001). NTIS $11.00.

Elevated temperature tensile and stress rupture properties were evaluated for forged TDNiCr (Ni–20Cr–2ThO_2) and related to thermomechanical history and microstructure. Forging temperature and final annealed condition had pronounced influences on grain size which, in turn, was related to high temperature strength. Tensile strength improved by a factor of 8 as grain size changed from 1 to 150 microns. Stress–rupture strength was improved by a factor of 3 to 5 by a grain size increase from 10 to 1000 microns. Some contributions to the elevated temperature strength of very large grain material may also occur from the development of a strong texture and a preponderance of small twins. Other conditions promoting the improvement of high temperature strength were: an increase of total reduction, forging which continued the metal deformation inherent in the starting material, a low forging speed, and prior deformation by extrusion. The mechanical properties of optimally forged TDNiCr compared favorably to those of high-strength sheet developed for space shuttle application. (auth)

23260 (RN-S-0523) SUBCRITICAL CRACK GROWTH IN BERYLLIUM AT –320°F. Green, A. T.; Hartbower, C. E.; Crimmins, P. P. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 32p. Dep. NTIS $4.75.

Compact tension tests (Manjoine Wedge Opening Loading design) of vacuum-hot-pressed, S200-grade beryllium were conducted at –320°F. Instrumentation included piezoelectric accelerometers and electric-resistance strain gages. The objective of the tests was to evaluate the subcritical-crack-growth characteristics of S200-grade beryllium under plane-strain conditions. The stress-wave-analysis technique revealed discontinuous crack growth at –320°F prior to the final plane-strain (K_{Ic}) instability. The crack toughness of the beryllium tested was 16.4 ksi-$in.^{\frac{1}{2}}$ at –320°F. (auth)

23261 (RP-DR-0004) PHOEBUS-2 SIX MONTHS MATERIALS DEVELOPMENT REPORT FOR 15 FEBRUARY 1966–15 AUGUST 1966. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 132p. Dep. NTIS $9.75.

Work performed on the Phoebus-2 program during the period 15 February 1966 through 15 August 1966 is reviewed. Results of materials activities performed under the development phases of the contract in the specific areas of properties determinations, welding, brazing, special testing and material, and component procurement support are summarized. Data and information are included on the properties program, welding development, brazing development, thermal cycling of heat transfer tubes, coolant tube metallurgical examinations, material procurement, and nozzle procurement support. (JRD)

23262 (SAND-75-6002) STUDY OF PHASE TRANSFORMATIONS IN TITANIUM ALLOYS. I. Contribution to the Study of the Kinetics of Transformations in the Titanium Alloy $Ta_6V_6E_2$. Klima, R.; Quemper, F.; Beauvais, C.; Roux, C.; Rapin, M.; Hocheid, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). Feb 1975. Translation of CEA-R-4542. 91p. Dep. NTIS $7.75.

A study of the alloy $Ta_6V_6E_2$ (Ti–6% Al–6% V–2% Sn) from the high-temperature-stable β_0 phase revealed the following characteristics: The ($\alpha + \beta \rightleftharpoons \beta_0$) transformation takes place at 955°C, accompanied by a slight dilatometric anomaly. The M_d point at which the V content of the β phase is sufficient for the phase to be retained at ambient temperature) is 825°C. The M_s point (martensitic transformation of the bcc β_0 parent phase into hcp α' phase) is near 700°C. A γ phase of the Ti_3 Al type appears at 875-825°C. The very high hardness after water hardening from temperatures above 900°C are comparable to the hardness of the "omega" phase in several Ti alloys. Isothermal decomposition of the β_0 phase after pretreatment at 1025°C for 30 min is summarized by the TTT curves. The beginning-of-transformation curve is C-shaped with a nose at around 750°C, with very short incubation times. From 900 to 700°C, the decomposition of the β_0 parent phase occurs by nucleation and growth of the α phase according to the reaction $\beta_0 \rightarrow \alpha + \beta$. From 700 to 600°C, a portion of the β_0 parent phase is transformed into α' martensite and the decomposition then occurs by the reactions $\beta_0 \rightarrow \alpha + \beta$ and $\alpha' \rightarrow \alpha + \beta$. In this temperature range, the instability of the α' martensite decreases with temperature. From 500 to 400°C, the extremely high hardness might indicate the formation of "omega" phase, either during cooling to these temperatures or during the isothermal hold. A distinct transition appears in the micrographic structures at 700°C: Above this temperature, the structure is interlaced or of the "wickerwork" type; below this temperature, the initially "acicular" structure becomes less evident as the temperature drops. The treatments selected in the various temperature ranges of the TTT curves show an increase of the breaking stress and a decrease of the plasticity. Dissolution in the one-phase β_0 field contributes to a coarsening of the grain. An isothermal treatment after pretreatment in the (α-β) field might reduce the brittleness of this $Ta_6V_6E_2$ alloy, which is already superior to the Ta_6V alloy in regard to its breaking stress and hardenability. (auth)

23263 HALL COEFFICIENTS OF BERYLLIUM. Shiozaki, I. (Tokyo Metropolitan Univ. (Japan)). Phys. Lett., A; 50: No. 3, 203-204(2 Dec 1974).

The Hall coefficients (R_H) of beryllium single crystals were measured in the range 4.2 to 300°K. At 290 K $R_{H\parallel}$ and $R_{H\perp}$ are (-7.64 ± 0.4) and $(+14.8 \pm 0.2) \times 10^{-10}$ m^3/A sec, respectively. Both $R_{H\parallel}$ and $R_{H\perp}$ are weakly dependent on temperature. (auth)

23264 LOW-TEMPERATURE HEAT CAPACITY OF $PrCu_2$. Wun, M.; Phillips, N. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., A; 50: No. 3, 195-196 (2 Dec 1974).

New measurements of the heat capacity of $PrCu_2$, between 70° mK and 20°K, are reported. The 7°K anomaly appears to be associated with a Jahn-Teller distortion. A value of $1 + K = 29$ is obtained for the "Knight shift" of the Pr nuclei. (auth)

23265 TRICRITICAL BEHAVIOR IN DySb. Streit, P.; Everett, G. E.; Lawson, A. W. (California Univ., Riverside (USA)). Phys. Lett., A; 50: No. 3, 199-200(2 Dec 1974).

A tricritical point was observed between two magnetically ordered phases in DySb at 8.5°K and 14.7 kOe. A triple point was observed at 9.7°K and 12.4 kOe. (auth)

23266 ON NONLINEAR KINEMATIC HARDENING PLASTICITY THEORY. Rashid, Y. R. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Nucl. Eng. Des.; 29: No. 1, 135-140(Nov 1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Experimental data for metals, e.g., stainless steel, at elevated temperatures show that the loop of the stress-strain curve obtained in a cyclic tension test grows in size in a bounded fashion with each successive cycle. This implies that either the material follows isotropic hardening during its initial deformation phase from the virgin state, or that the material obeys the kinematic rule by maintaining constant elastic range but with continuously increasing hardening. The known experimental data seems to favor the latter assumption, in which case the classical linear kinematic hardening rule could not adequately describe the cyclic behavior of the material. It becomes necessary, therefore, to generalize the linear hardening rule to nonlinear hardening and furthermore to make the shape of the plastic portion of the stress-strain curve variable with the number of cycles. A development is presented of a nonlinear kinematic hardening rule which admits the use of nonlinear stress-strain curves whose shapes can be varied as functions of the number of cycles. It will be shown that the proposed rule leads to a yield surface that depends explicitly on past history in a special way. It will also be shown that, within the original framework of Prager's kinematic hardening postulate, the proposed generalization to nonlinear hardening admits radial as well as nonradial loading for initially isotropic material. A Ramberg–Osgood form of the stress-strain curve will be utilized to demonstrate the utility of the method and, by making the parameters in the stress-strain curve cycle dependent, a cyclic stress-strain curve which grows with the number of cycles can be adequately represented. Finally, an incremental stress-strain relation which can be used in structural analysis is derived on the basis of the proposed nonlinear kinematic hardening rule. (auth)

23267 THE APPLICATION OF CHANNELING FOR LOCATING IMPURITY ATOMS AND INVESTIGATING IMPURITY DEFECT INTERACTIONS IN ZIRCONIUM. Swanson, M. L.; Howe, L. M. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 54: No. 1, 155-158(Nov 1974).

The displacement of Au atoms into [0001] channels in α–Zr was investigated after 2 MeV He^+ irradiation at 40°K and after subsequent annealing to 400°K. The results confirm those of

Neely (1970), who found in electron-irradiated Zr that long range migration of self-interstitial Zr atoms occurred in the temperature range 120 to 150°K. From the annealing results, it appears that some trapping of self-interstitials occurs below 100°K; this could correspond to correlated interstitial-vacancy recombination. Stage II recovery, from 150 to 250°K, did not affect the position of the Au atoms. A small (15%) reduction in the displacement of Au atoms was observed from 250 to 320°K, where Neely found evidence for a freely migrating defect (Stage III recovery). If this recovery were due to vacancy migration, a much larger reduction would be observed. Thus, as proposed by Neely, the Stage III recovery could be due to motion of a second type of interstitial, which might reduce the Au atom displacements slightly by double trapping. (auth)

23268 URANIUM DIFFUSION INTO FISSION CHAMBER ELECTRODES. Boeck, H.; Seidl, E.; Zeilinger, A. (Atominstitut der Oesterreichischen Hochschulen, Vienna). J. Nucl. Mater.; 54: No. 1, 159-162(Nov 1974).

In large boiling water reactor cores the local flux distribution is monitored continuously with in-core fission chambers. These fission chambers are exposed to high neutron- and gamma-fluxes, high temperatures and high pressure and should be in operation as long as possible. Therefore high quality standards are necessary for all parts of the fission chamber in order to achieve an acceptable lifetime. One critical part of the fission chamber is the uranium coated electrode. The electrode is usually a titanium cylinder and may be coated by several methods with highly enriched ^{235}U. This process should result in an even uranium distribution on the surface and a high adhesive strength of the uranium to the titanium. Because of the fission energy released in the uranium layer the temperature of the electrode will be considerably above the ambient temperature of the fission chamber. Therefore temperature-induced diffusion of uranium into the titanium is possible and will result in a decreased fission chamber sensitivity because of the short range of the fission fragments. These investigations analyze the temperature- and time-dependence of diffusion of uranium atoms into titanium by different means. (auth)

23269 THE EFFECT OF CARBON ON 2.25 Cr−1 Mo STEEL. I. Microstructure and Tensile Properties. Klueh, R. L. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 54: No. 1, 41-54(Nov 1974).

The microstructure, hardness, and the tensile properties of 2.25 Cr−1 Mo steel with 0.009, 0.030, 0.120, and 0.135 wt % C were determined on steels in the annealed (furnace-cooled from 927°C), normalized (air-cooled from 927°C), and normalized-and-tempered conditions. As annealed, the microstructure was primarily proeutectoid ferrite with spherical carbides and pearlite, the amounts increasing with increasing carbon content. During normalization ($\frac{7}{8}$ in rods or 1 in plates were heat-treated), granular bainite formed: 1 to 2 and 15 to 20% bainite (remainder proeutectoid ferrite) for the 0.009 and 0.030 wt % C steels, respectively; the 0.120 and 0.135 wt % C steels were entirely bainite. On tempering, carbides precipitated. In all heat-treated conditions, there was little difference in the room temperature hardness of the 0.009 and 0.030 wt % C steels and between the 0.120 and 0.135 wt % C steels. Tensile tests from 25 to 565°C indicated that strength depends on microstructure, which is determined by carbon content. (auth)

23270 THE EFFECT OF CARBON ON 2.25 Cr−1 Mo STEEL. II. Creep-Rupture Properties. Klueh, R. L. (Oak Ridge National Lab., Tenn. (USA)). J. Nucl. Mater.; 54: No. 1, 55-63 (Nov 1974).

The creep-rupture properties of normalized-and-tempered 2.25 Cr−1 Mo steel with 0.009, 0.030, 0.120, and 0.135 wt % C were determined at 454, 510, and 565°C; the results show an effect of carbon that depends on temperature. At all three temperatures, the 0.120 and 0.135 wt % C steels have similar strengths, and at 565°C are considerably stronger than the 0.009 and 0.030 wt % C steels, which also have similar strengths. At 454 and 510°C, however, the properties for the 0.030 wt % C steel are superior to those of the 0.009 wt % C steel and approach those for the 0.120 and 0.135 wt % C steels. These observations can be explained in terms of the type of carbide precipitation reactions that occur in 2.25 Cr−1 Mo steel. (auth)

23271 IN-REACTOR CREEP OF ZIRCALOY-2, ZIRCALOY-4 AND Zr-1.15 wt % Cr−0.1 wt % Fe AT 568°K DERIVED FROM THEIR STRESS-RELAXATION BEHAVIOR. Causey, A. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 54: No. 1, 64-72(Nov 1974).

The in-reactor stress-relaxation of zirconium alloys can be represented by the equation $\sigma/\sigma_0 = D \exp(-Kt)$ where the unrelaxed stress ratio is equal to a factor times the exponential of the relaxation rate. Creep rates derived from the bent-beam stress-relaxation data are compared with uniaxial creep results and a good correlation is shown for Zircaloy-2 through a continuous trend curve from low-stress stress relaxation to the high-stress creep behavior. Specimens quenched from the β-phase had the lowest creep rates compared with those which were annealed or cold-worked, while increasing cold-work increased the creep rates for most specimens. The effects of cold-work and results from post-irradiation annealing of stress-relaxation test specimens suggest that for the low stress regime ($\sigma < \frac{1}{3}\sigma$ yield) the operation of a dislocation climb/glide mechanism in addition to the stress-directed loop formation mechanism is required for in-reactor creep. (auth)

23272 THE EFFECT OF HIGH PRESSURE ON THE ELECTRIC QUADRUPOLE INTERACTION AT TANTALUM IN α−ZIRCONIUM. Butz, T.; Wortmann, G.; Kalvius, G. M. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.); Holzapfel, W. B. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (F.R. Germany)). Phys. Lett., A; 50: No. 2, 127-128(18 Nov 1974).

The isothermal pressure coefficient of the electric field gradient at Ta in α−Zr was determined to be $+3.85(28) \times 10^{-3}$ $kbar^{-1}$ at 300°K. It is shown that the spatial re-arrangement of conduction electrons under pressure plays the dominant role. (auth)

23273 BAND STRUCTURE MASS AND THE MASS ENHANCEMENT FACTOR IN CADMIUM: APPLICATION TO CdMg ALLOYS. Boyd, J. R. (Southern Methodist Univ., Dallas, Tex. (USA)); Gordon, W. L. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Physics); Tripp, J. H. (Connecticut Univ., Storrs (USA). Dept. of Physics). Phys. Lett., A; 50: No. 2, 91-92(18 Nov 1974).

The Stark−Falicov pseudopotential model was used to calculate the band structure mass for hole orbits on the Cd Fermi surface near the point H and yields a mass enhancement of 0.40. Changes of these orbits in CdMg alloys are interpreted. (auth)

23274 PAIR-BREAKING IN THIN SUPERCONDUCTING FILMS. The Effects on T_c and Fluctuation Conductivity. Granqvist, C. G.; Claeson, T. (Chalmers Tekniska Hoegskola, Goteborg). Solid State Commun.; 16: No. 1, 123-125(1 Jan 1975).

The thickness-dependent pair-breaking parameter, inherent in the Maki−Thompson contribution to the excess conductivity due to superconducting fluctuations, is found to be equal to the observed shift of T_c relative to the bulk value. Measurements were performed on thin amorphous $Be_{0.7}Al_{0.3}$ films produced by vapour quenching. (auth)

23275 MAGNETIC SUSCEPTIBILITIES OF PROTACTINIUM(IV), URANIUM(IV), AND NEPTUNIUM(IV) TETRAFORMATES. Schenk, H. J.; Bohres, E. W.; Schwochau, K. (Kernforschungsanlage, Juelich, Ger.). Inorg. Nucl. Chem. Lett.; 11: No. 3, 201-206(Mar 1975).

Anhydrous tetraformates of protactinium(IV), uranium(IV), and neptunium(IV) were prepared by reaction of the corresponding tetrachlorides with thoroughly dried formic acid. Magnetic susceptibilities were measured in a field of 6.55 KGauss by means of a Faraday apparatus which was calibrated with a $HgCo(SCN)_4$ standard. Measurements were made from 80°K up to room temperature in steps of approximately 20°. Within the temperature range of 80 to 300°K the tetraformates of protactinium(IV), uranium(IV), and neptunium(IV) obey the Curie-Weiss law $\chi = C/(T-\theta)$ with extrapolated Weiss constants of $\theta = -3$, -90 and -86°K respectively. All susceptibility data and effective magnetic moments $\mu_{eff} = 2.83\sqrt{C}$ [B.M.] are summarized. The results are discussed in relation to crystal structure and electronic structure. (auth)

23276 MAGNETIC SUSCEPTIBILITY AND SUPERCONDUCTIVITY OF CUBIC VANADIUM NITRIDES. Ajami, F. I. (Univ. of Pennsylvania, Philadelphia); MacCrone, R. K. J. Phys. Chem. Solids; 36: No. 1, 7-15(Jan 1975).

The superconducting transition temperature T_c and the magnetic susceptibility from 77 to 300°K have been measured on five cubic vanadium nitrides: VN, $VN_{0.91}$, $VN_{0.87}$, $VN_{0.84}$ and $VN_{0.75}$. The materials were carefully prepared to exclude oxygen and ferromagnetic impurities. The value of T_c falls from 8.1°K for VN to 2.3°K for $VN_{0.75}$. The mass-susceptibility decreased from $+3.94 \times 10^{-6}$ e.m.u./g for VN to 1.88×10^{-6} e.m.u./g for $VN_{0.75}$ at 300°K. All samples showed a small positive slope for the susceptibility temperature curve. The results are discussed in terms of the rigid-band model. The main features are a high density of states of d electrons, 2.4 states/atom·eV for VN that drops off as the nitrogen content decreases, to 0.8 states/atom·eV. Preliminary considerations indicate that many-body effects could

reduce this density of states by as much as a factor of 2. Lack of experimental results on Knight shifts and low-temperature specific heats prevent a more quantitative estimate being made. (auth)

23277 PRESSURE-ENHANCED SUPERCONDUCTIVITY AND SUPERLATTICE STRUCTURES IN TRANSITION METAL DICHALCOGENIDE LAYER CRYSTALS. Molinie, P.; Jerome, D.; Grant, A. J. (Univ., Nantes, France). Phil. Mag.; 30: No. 5, 1091-1103(Nov 1974).

The pressure dependence of the superconducting transition temperature T_c is investigated for the metallic layer crystals 2H NbS_2 and 2H $NbSe_2$. In 2H NbS_2, T_c is pressure-independent, as in the 3R polytype. It is suggested that the pressure-enhanced T_c in 2H $NbSe_2$ may be related to recent observations in electron diffraction and NMR of a phase change to a superlattice structure in this material at low temperatures. The results would tend to rule out the model of pressure-dependent Josephson tunnelling between layers suggested by previous authors. The anisotropy and pressure dependence of the critical field H_{c_2} are described. (auth)

23278 MEASUREMENTS OF CRITICAL FIELDS UP TO 500 kG IN THE TERNARY MOLYBDENUM SULPHIDES. Fischer, O.; Jones, H.; Bonji, G.; Sergent, M.; Chevrel, R. (Univ., Geneva). J. Phys., C (London); 7: No. 24, L450-L453(21 Dec 1974).

Using slowly pulsed magnetic fields up to 510 kG it is shown that some lead-rich ternary molybdenum sulphides have critical fields above 500 kG, whereas the Sn-rich compounds have critical fields of the order of 300 to 400 kG. (auth)

23279 EFFECT OF PROCESS TEMPERATURE AND TIME ON THE SUPERCONDUCTING CRITICAL TEMPERATURE OF MULTIFILAMENTARY V_3Ga PRODUCED BY SOLID STATE REACTION. Dew-Hughes, D. (Univ. of Lancaster, Eng.). Cryogenics; 14: No. 12, 657-658(Dec 1974).

A study is reported on the feasibility of preparing multifilamentary V_3Ga by external diffusion. It was concluded that due to the difficulty of wetting copper with gallium, and because a high percentage of gallium in solid solution in both the copper and the vanadium is necessary to achieve reasonable growth rates for the compound, the external diffusion method is not a serious rival to the bronze route in producing V_3Ga. In the process of the investigation the effect of reaction time and temperature on the transition temperature were studied and it was found that formation or annealing at temperatures in excess of 700°C caused thermal disordering of the V_3Ga; that at temperatures below 650°C the ordering process was too sluggish, and that optimum reaction temperature for V_3Ga was ~675°C. Reaction time had to be such that the compound layer thickness at which internal stresses become important was not exceeded. Large overall current densities could be achieved by decreasing the size and increasing the number of vanadium filaments in the composite. (UK)

23280 EFFECT OF DISPERSED OXIDE INCLUSIONS ON THE RECRYSTALLIZATION OF A METAL MATRIX. Antsiferov, V. N. Nauch. Tr., Perm. Politekh. Inst.; No. 131, 171-184(1973). (In Russian).

Studies were made of the effect of dispersed Al_2O_3 and ZrO_2 inclusions on recrystallization in Cr, Ni, and Ni–Cr alloys. The process was accelerated when small volume contents of these refractory oxides were present; with higher concentrations the temperature of the secondary recrystallization increased, grain growth was checked, and the high hardness of the recrystallized alloys retained. The temperature for the onset of secondary recrystallization were: 900 for pure Cr, and for Cr containing ZrO_2 1.3 or Al_2O_3 1.8%, and 1000°C for Cr containing ZrO_2 3.8 or 6.3, or Al_2O_3 5.3%. In the temperature range studied no secondary recrystallization was observed for alloys containing ZrO_2 8.8 or Al_2O_3 8.6%. (Ref. Zh.)

23281 DE HASS–VAN ALPHEN MEASUREMENTS OF THE ELECTRON CYCLOTRON MASS IN W. Feenan, P. J.; Myers, A.; Sang, D. (Univ. of Leeds, Eng.). Solid State Commun.; 16: No. 1, 35-39(1 Jan 1975).

Measurements of the cyclotron effective mass are reported on the hole octahedron surface in tungsten. These have been combined with published measurements of the extremal cross-sectional area to give information on the anisotropy of the electron velocity. Details of cubic harmonic fits to the mass and k-vector are given. (auth)

23282 PHOTOELECTRIC PROPERTIES OF EVAPORATED Be FILMS. Gustafsson, T.; Broden, G.; Nilsson, P. O. (Chalmers Tekniska Hoegskola, Goteborg). J. Phys., F (London); 4: No. 12, 2351-2358(Dec 1974).

Energy distributions of photoelectrons from Be were measured. Semi-quantitative agreement with calculated curves based on direct transitions was obtained. The work function was determined to 4.98 eV. Effect of some gases on the experimental spectra is discussed. (auth)

23283 OPTICAL CONSTANTS OF GADOLINIUM AND TERBIUM FILMS OBTAINED FROM IN SITU REFLECTION MEASUREMENTS IN ULTRA HIGH VACUUM. Miller, R. F.; Julien, L. S.; Taylor, A. J. (Royal Holloway Coll., London). J. Phys., F (London); 4: No. 12, 2338-2350(Dec 1974).

The optical constants n, k, and $\sigma(\omega)$ of paramagnetic Gd and Tb were determined from in situ reflection measurements on opaque films prepared in ultra high vacuum ($\sim 10^{-10}$torr). Optimized reflection ratio measurements at oblique incidence in the photon energy range 1.8 to 3.1 eV give evidence of direct optical transitions at 1.95, 2.15, 2.50, 2.75, and 3.1 eV for gadolinium and at 1.90, 2.20, and 2.45 eV for terbium. Deductions from electronic band structure calculations for the bulk materials predict optical transitions at 2.0, 2.2, 2.4 to 2.6, 2.8, and 3.1 eV for gadolinium, and at 1.9, 2.2 and 2.5 eV and other energies for terbium. (auth)

23284 MAGNETIC PROPERTIES OF SAMARIUM. McEwen, K. A.; Touborg, P. F.; Cock, G. J.; Roeland, L. W. (Danmarks Tekniske Hoejskole, Lynby). J. Phys., F (London); 4: No. 12, 2264-2268(Dec 1974).

High-field (30 MA m^{-1}) magnetization measurements at 4.2 and 20.4°K on samarium single crystals are reported together with low-field studies from 1.8 to 130°K. The susceptibility results are analyzed in terms of independent contributions from the moments on the cubic and hexagonal sites (which order antiferromagnetically at 14 and 109°K respectively), plus a temperature-independent susceptibility. At 4.2°K, a spin-flop transition on the cubic sites was observed around 21.6 MA m^{-1}. Using one anisotropy and two exchange parameters, a molecular field model correctly describes the main features of the behaviour on the cubic sites, and their saturation moment is calculated to be 0.47 μ_B/atom. (auth)

23285 TEMPERATURE DEPENDENCE OF THE ELECTRIC FIELD GRADIENT AT TANTALUM IN GROUP IIIb METALS: SCANDIUM, YTTRIUM, LUTETIUM. Butz, T.; Kalvius, G. M. (Techniske Univ., Munich). J. Phys., F (London); 4: No. 12, 2331-2337(Dec 1974).

The electric field gradient at ^{181}Ta in hcp Sc, Y, and Lu was determined at 4.2 and 450°K by the time differential perturbed angular correlation technique. A uniform, axially symmetric, essentially undamped quadrupole interaction was found at all temperatures. The field gradients at room temperature have the values $|eq| = 5.1(2), 5.9(3), 5.0(2) \times 10^{17}$ V cm^{-2} for Sc, Y, and Lu, respectively. The temperature dependence of the field gradient at Ta in Lu can be explained fully by the lattice expansion. Results for TaSc and in particular for TaY indicate a thermal repopulation of conduction electron states. (auth)

23286 MAGNETIC PROPERTIES OF SOME Gd–Sm AND Gd–Nd ALLOYS. Fujimori, H.; Goto, K.; Williams, D. E. G. (Loughborough Univ. of Tech., Eng.). J. Phys., F (London); 4: No. 12, 2152-2156(Dec 1974).

Measurements have been made of the magnetizations of Gd–Sm and Gd–Nd alloys with Gd contents greater than about 75%. The magnetic moments of these alloys in the hcp phase can be interpreted as indicating that in these alloys the samarium atoms carry magnetic moments of $0.9 \pm 0.3\beta$, and the neodymium atoms carry magnetic moments of $3.3 \pm 0.1\beta$, and that these moments are aligned ferrimagnetically with the Gd atomic magnetic moments. (auth)

23287 THERMOMAGNETIC HISTORY EFFECTS IN $LaCo_{5x}Ni_{5-5x}$ AND $ThCo_{5x}Ni_{5-5x}$ COMPOUNDS. Buschow, K. H. J.; Brouha, M.; Rijnbeek, A. G. (Philips Gloeilampenfabrieken N. V.; Eindhoven, Netherlands). Solid State Commun.; 16: No. 1, 31-34(1 Jan 1975).

The magnetization versus temperature curves of several compounds of the series $LaCo_{5x}Ni_{5-5x}$ were found to give rise to an abrupt increase at temperatures being higher in accordance as the applied field strengths are smaller. The magnetic properties strongly depend on the magnetic as well as on the thermal history. The observed magnetic behaviour is discussed in terms of mictomagnetism and narrow Bloch wall propagation. (auth)

23288 EFFECT OF UNIAXIAL STRESS ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF $NbSe_2$. Sambongi, T. (Hokkaido Univ., Sapporo). J. Low Temp. Phys.; 18: No. 1-2, 139-146(Jan 1975).

The superconducting transition temperature T_c of 2H $NbSe_2$ was measured under uniaxial stress applied parallel to the crystal c axis. It was found that T_c decreases as the increasing applied compression, while it increases under hydrostatic pressure. It

is concluded that T_c is strongly enhanced by the contractive strain within layers and is insensitive to the interlayer spacing. (auth)

23289 NUCLEAR RELAXATION IN LANTHANUM RARE EARTH ALLOYS. Wade, R. F. Urbana, IL; Univ. of Illinois (1974). 130p. University Microfilms Order No. 74-27,787. Thesis (Ph. D.).

The nuclear spin lattice relaxation rate of ^{139}La was studied by pulsed NMR techniques in alloys of La with Ce, Pr, Nd, Gd, and Lu. The host lanthanum Korringa relaxation rate (measured as $T_1T = .45$ sec °K ± 1%) is enhanced due to the magnetic impurities; this is attributed to the conduction electron-mediated, simultaneous host nuclear spin-impurity electronic spin flip mechanism (BGS). The impurity contribution to the relaxation rate was found to be linear up to 10 at.% Ce and Pr. Temperatures between 1.4 and 4.2°K were investigated, and the applied magnetic field was varied from 15.6 to 50 kOe. Studies were also made of the two stable crystalline structures of the alloys, fcc and dhcp. Other frequently cited indirect and direct mechanisms fail to consistently describe all aspects of the observed behavior, whereas all of the data are consistent with the predictions of the BGS mechanism. From the field dependence of the nuclear relaxation rate enhancement, electronic transverse relaxation times of the Ce and Nd impurities are deduced independently of the free electron approximations, the theoretical BGS equation and without assumptions about the magnitude of the s-f exchange energies. It is concluded that the τ_2's are independent of temperature, magnetic field, and impurity concentration. For Ce, in fcc La:Ce, $\tau_2 = (1.8 \pm .3) \times 10^{-12}$ s. For Nd, $\tau_2 = (.9 \pm .2) \times 10^{-12}$ s is found also in the fcc La structure. The electronic relaxation is apparently structure dependent. For Ce in dhcp La:Ce, $\tau_2 \simeq 1 \times 10^{-12}$ s. The BGS relaxation enhancement equation also is shown to predict s-f exchange energies having order of magnitude agreement with those obtained from analysis of resistivity and superconducting transition temperature depression data. This supports the applicability of the free electron approximations used in the derivation of the BGS rate equation. The conduction electron-mediated virtual excitation mechanism is shown to be approximately three orders of magnitude weaker than BGS, even at 50 kOe. The proton spin lattice relaxation time in $(La:Ce)H_x$ is shown to be linear in Ce concentration from 0 to 100%. The observed T_1's span four orders of magnitude. This behavior is examined as an analytical tool for estimating the rare earth impurity level in "pure" lanthanum. (Diss. Abstr. Int., B)

23290 NEW RESONANCE EFFECTS IN THE SURFACE IMPEDANCE OF CADMIUM. Weir, J. E. Seattle; Univ. of Washington (1974). 104p. University Microfilms Order No. 74-29,524. Thesis (Ph. D.).

The existence of resonant structure in the surface impedance at the cyclotron frequency with a magnetic field normal to a metal surface, first reported by Powell and Eck in magnesium, is confirmed in cadmium. A careful semi-classical calculation of the surface impedance is carried out for this situation, and yields a nonresonant result. The cyclotron resonance signal is studied under a variety of experimental conditions in an attempt to identify at which point theory fails. The effects on the resonance of temperature, magnetic field tip, misorientation of crystal axes, surface roughness, sample thickness, and electric field polarization are investigated. The peak position is found to be within 1% of that predicted by Azbel'–Kaner resonance, although a 0.7% anisotropy in the cyclotron frequency in the basal plane of the cadmium "lens" is reported for the first time. With the magnetic field in certain tipped configurations, the cyclotron resonance peak breaks up into a series of high frequency oscillations which are identified as quantum oscillations of the Schubnikov–de Haas type. A quantum mechanical modification of the semi-classical theory is made which predicts a resonance at the cyclotron frequency, and accounts for part of the resonance lineshape. The remaining line is not explained, but suggestions are made as to where the theory might be improved to account for this also. (Diss. Abstr. Int., B)

23291 PHASE DIAGRAM OF THE SYSTEM VANADIUM–GOLD AND THE SUPERCONDUCTING PROPERTIES OF THE V_3Au PHASE. Fluekiger, R.; Susz, C.; Heiniger, F.; Muller, J. (Univ., Geneva). J. Less-Common Metals; 40: No. 1, 103-119(Mar 1975).

The equilibrium phase diagram of the V–Au system was redetermined by x-ray, differential thermal analysis, electrical resistivity, and micrographic techniques. The bcc, V-rich α phase extends to 33 at. % Au at high temperature and undergoes a eutectoid decomposition at 1244°C. The limiting concentrations of the A15 type β phase are 19.5 and 24 at. % Au, the latter being reached at the eutectoid temperature. A detailed study of the atomic ordering in the β phase was carried out as a function of different thermal treatment, and relations between the degree of order and the superconducting transitions are established. (13 figures) (auth)

23292 SOLID SOLUTION HARDENING IN THE ZIRCONIUM–OXYGEN SYSTEM. Ruano, O.; Elssner, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Less-Common Metals; 40: No. 1, 121-128(Mar 1975).

Zirconium–oxygen alloys containing between 0.02 and 1.05 at. % oxygen were prepared by engassing β-Zr at 1500°C followed by an anneal at 800°C. Conventional stress–strain measurements as well as strain-rate-change tests were made. The yield point was determined in the range from 77 to 500°K for wire samples with an α-Zr bamboo structure, and the hardening coefficient, $\Delta\tau/\Delta C$, was found to vary from 0.52 μ at 77°K to 0.36 μ at 300°K. Observations with the electron microscope under weak-beam conditions demonstrated the presence of clusters inside the Zr matrix. For the temperature range 0–500°K, two rate-controlling mechanisms are indicated. Below approximately 300°K, the flow stress is composed of a temperature-dependent component, caused by the interaction between dislocations and single, interstitial oxygen atoms, and a temperature-independent contribution due to an interaction with stable oxygen clusters. Above about 300°K, the onset of plastic deformation is determined by the overcoming of clusters. (9 figures) (auth)

23293 EFFECTS OF HYDRIDE PRECIPITATES ON THE MECHANICAL PROPERTIES OF ZIRCONIUM–HYDROGEN ALLOYS. Gill, B. J. (National Gas Turbine Establishment, Pyestock, Eng.); Bailey, J. E.; Cotterill, P. J. Less-Common Metals; 40: No. 1, 129-138(Mar 1975).

The mechanical behavior of Zr–H alloys of low hydrogen content (100 to 600 ppM) was examined at room temperature under tensile-testing conditions at absolute strain rates in the range 10^{-4} to 10^{-2} s^{-1}. Alloy microstructure and constitution were modified by means of variations in the cooling rate from the α phase field and it is shown that the reduction in elongation with increasing hydrogen content depends on the volume fraction of hydride present. Failures at strains of ~1% were related to the presence of continuous networks of precipitate throughout the specimens and, under these conditions, it is shown that the hydrides δ and γ are equally effective embrittling agents. The strains to failure of zirconium and dilute Zr–H alloys are shown to be markedly reduced in the presence of notches. (12 figures) (auth)

23294 LATTICE PARAMETER OF NIOBIUM BETWEEN 4.2 AND 300°K. Roberge, R. (IREQ, Varennes, Quebec). J. Less-Common Metals; 40: No. 1, 161-164(Mar 1975).

Lattice parameter and linear thermal expansion measurements were made in a cryostat. The parameter a was found to be 3.3030 Å at 120°K, 3.3035 Å at 160°K, 3.3042 Å at 200°K, 3.3056 Å at 250°K, and 3.3063 Å at 295°K. (DLC)

23295 EFFECTS OF YTTRIUM OR GADOLINIUM ON THE SUPERCONDUCTING TRANSITION TEMPERATURE OF NIOBIUM. Koch, C. C.; Kroeger, D. M. (Oak Ridge National Lab., TN). J. Less-Common Metals; 40: No. 1, 29-38(Mar 1975).

It was found that on quickly cooling from the liquid state during casting, enough Y or Gd was trapped in solid solution in niobium to change the physical properties of the niobium. In particular, the superconducting transition temperature, T_c, of Nb was sensitive to small amounts of Y or Gd in solid solution. Yttrium in solid solution raised the T_c of Nb, while Gd lowered it. On annealing the cast specimens at temperatures up to 1500°C, the Y or Gd precipitates out of solution and the physical properties of niobium revert to those of pure niobium. In addition to the transition temperature (T_c), the superconducting critical field, (H_{c_2}), the normal state electrical resistivity (ρ), the x-ray lattice parameter (α_0), and optical and electron microscopy, were used to study the Nb–Y and Nb–Gd alloys. (4 tables, 3 figures) (auth)

23296 STANDARD GIBBS FREE ENERGY OF FORMATION OF Pu_2Ni_{17}. Campbell, G. M. (Los Alamos Scientific Lab, NM). J. Chem. Thermodyn.; 6: No. 11, 1110-1112(Nov 1974).

Nickel-rich binary alloys of plutonium form hexagonal Pu_2Ni_{17} which is in equilibrium with nickel metal at compositions above 89.5 mole % nickel. To determine the activity of plutonium in nickel-rich alloys, galvanic cells containing alloy electrodes of two types were used. One alloy was prepared by electrodepositing a thin film of plutonium on to a pure nickel base. From the results, the standard Gibbs free energy of formation of Pu_2Ni_{17} is $\Delta G^0(T)/kJ\ mol^{-1} = -(172.0 \pm 1.1) + (0.0290 \pm 0.0022)(T/K)$. The other electrode was fabricated by arc melting and annealing the two metals to obtain an alloy containing 94.22 mole % Ni. This results in a two-phase alloy with 54.3 mole % of Ni in the Pu_2Ni_{17} phase and 45.7 mole % of Ni in the nickel saturated with dissolved plutonium phase. The emf's for cells with the two types of electrodes, using plutonium metal as a reference electrode, indicated that solid-state equilibrium was not maintained in the arc-melted alloy at the temperature used (~900 to 1100°K). (UK)

23297 SOLID-SOLUTION HARDENING OF THE TERNARY SYSTEM. Ruf, P.; Koss, D. (Michigan Technological Univ., Houghton). Phil. Mag.; 30: No. 6, 1319-1326(Dec 1974).

Measurements of the yield stress as a function of the solute content are reported for a series of ultrahigh vacuum degassed Nb–Hf–W single crystals tested at 900°K. Tests of alloys containing up to 10 at. % (Hf + W) show that the yield stress increases with solute content in a nearly linear manner and that the rate of hardening per solute addition is the highest for the most concentrated alloys. Although second-phase precipitates are not expected and are not observed by transmission electron microscopy techniques, the yield stress of the concentrated Nb–Hf–W alloys is sensitive to heat treatment. A phenomenological analysis of the solid-solution hardening of ternary alloys in terms of the binary alloy hardening increments is presented for the case in which the solute atoms have different strengths as obstacles to dislocation motion. The analysis predicts the observed strengthening at total solute concentrations of less than about 5 at. %, but the observed rate of hardening exceeds that predicted at total solute concentrations greater than approximately 5 at. %. Results are discussed in terms of a nonrandom solute distribution, sensitive to heat treatment, which is important in determining the yield stress at larger solute concentrations. (auth)

23298 PHASE DIAGRAM AND THERMODYNAMIC PROPERTIES OF THE URANIUM–ZINC SYSTEM. Chiotti, P.; Mason, T. (Ames Lab., IA). J. Less-Common Metals; 40: No. 1, 39-55 (Mar 1975).

Literature data on the U–Zn system are reviewed and combined with new data to establish the phase relations and thermodynamic properties. The existence of two compounds, U_2Zn_{17} and UZn_{12}, was firmly established. The first compound undergoes a transformation at 724 ± 3°C on the U-rich side of the compound, at 824 ± 10°C on the Zn-rich side and melts congruently at 970 ± 5°C. UZn_{12} has a defect structure with a stoichiometry which ranges from $UZn_{9.4}$ to $UZn_{11.5}$. It undergoes a peritectic reaction at 768 ± 10°C. Other features of the phase relations are as originally reported. The standard free energies of formation (in calories) of the compounds are given by the relations ΔG^0 ($UZn_{9.5}$) = −46,530 + 30.87T (420–668°C); ΔG^0 ($UZn_{9.5}$) = −47,200 + 31.58T (668–724°C); ΔG^0 ($UZn_{9.4}$) = −45,395 + 29.78T (744–775°C); ΔG^0 ($UZn_{9.4}$) = −46,530 + 30.87T (775–970°C); ΔG^0 (UZn_{12}) = −52,750 + 36.73T (420–668°C); ΔG^0 (UZn_{12}) = −53,415 + 37.44T (668–775°C). (5 tables, 5 figures, 28 references) (auth)

23299 PHYSICAL AND MECHANICAL PROPERTIES OF URANIUM-(0.05-6 AT. %) RUTHENIUM ALLOYS. Hammad, F. F.; Abou-Zahra, A. A. (Atomic Energy Establishment, Cairo). J. Less-Common Metals; 40: No. 1, 79-90(Mar 1975).

The alloys were investigated in the as-cast and oil-quenched conditions, from 900°C and 720°C. The properties investigated were thermal expansion, crystalline lattice parameters, density and microhardness. As the Ru content increased, the coefficient of dilatation decreased in a manner depending upon the temperature. For the as-cast alloys, the orthorhombic lattice parameters of α-uranium, a, b, and c, decreased as the Ru content increased. For the alloys quenched from 900°C, the b parameter decreased and the a and c parameters increased with Ru content. These changes caused distortion in the unit cell by comparison with the as-cast condition, and produced x-ray line broadening. In the case of alloys quenched from 720°C, the α parameter was not significantly influenced, the b parameter was decreased, and the c parameter increased. The distortion in this case was insufficient to cause line broadening. In the as-cast alloys, the density decreased and the microhardness increased as the Ru content increased. The density of alloys quenched from 720°C was slightly higher than that of the as-cast alloys. Quenching from 900°C produced a greater increase in density than quenching from 720°C. The hardness values of alloys quenched from 720°C were slightly higher than those of the as-cast alloys. Quenching from 900°C produced considerable strengthening, particularly in the high Ru-content alloys. (3 tables, 8 figures) (auth)

23300 INFLUENCE OF DISSOLVED NON-METALS ON THE REACTION OF LIQUID LITHIUM WITH THE OXIDES OF NIOBIUM AND TANTALUM. Barker, M. G.; Bentham, J. (Univ. of Nottingham, Eng.). J. Less-Common Metals; 40: No. 1, 1-7(Mar 1975).

The oxides Nb_2O_5, NbO_2, NbO, $LiNbO_3$, Li_3NbO_4, Ta_2O_5, $LiTaO_3$ and Li_3TaO_4 are reduced by liquid lithium to the metal. No interaction is observed between oxygen dissolved in the liquid lithium and the metals niobium and tantalum. Reaction of the above oxides with liquid lithium containing dissolved nitrogen gives lithium oxide and the nitrides M_2N or MN (M = Nb or Ta). The carbonitride, $Nb_2(N,C)$ and the hydride $NbH_{0.8}$ are produced by the reaction of Nb_2O_5 with lithium containing nitrogen and carbon, and with lithium containing hydrogen, respectively. (auth)

23301 SUPERCONDUCTIVITY OF TaV_2. Schippnick, P. F.; Lawson, A. C. (Univ. of California, La Jolla, San Diego). Solid State Commun.; 15: No. 10, 1643-1644(15 Nov 1974).

Specific heat measurements show that the cubic Laves phase TaV_2 becomes superconducting at 3.6 K. Values of γ and θ_D for this compound are compared with those for ZrV_2 and HfV_2. (auth)

23302 POSITRON ANNIHILATION IN POLYCRYSTALLINE Al AND Th-ANGULAR DISTRIBUTION. Nagarajan, T.; Ramasamy, P.; Iyakutti, K.; Devanathan, V. (Madras Univ.). J. Phys., F (London); 5: No. 1, 81-84(Jan 1975).

A good geometry setup with well shielded collimators with zero background was designed. The transmission and resolution of the setup are 0.16×10^{-3}% and 0.8 mrad respectively. The angular correlations in aluminium and, for the first time, in thorium were performed with shielded 75 mCi ^{58}Co source. The density and momentum distributions are presented for Al and Th and their Fermi radii are 1.79 ± 0.1 $Å^{-1}$ for Al after subtracting the core contribution and 1.67 ± 0.12 $Å^{-1}$ for Th without subtracting the core contribution. (auth)

23303 MAGNETIZATION OF SUPERCONDUCTING TAPE IN A PERPENDICULAR FIELD. Shimamoto, S. (CEN de Saclay, Gif-sur-Yvette, France). Cryogenics; 14: No. 12, 641-646(Dec 1974).

The magnetization of a V_3Ga superconducting tape between two successive flux jumps has been experimentally determined by means of search coil measurement in an increasing field perpendicular to the surface. On the basis of these experimental results, an attempt is made to determine theoretically the current induced region as a function of only one parameter across the width, in order to calculate approximately the magnetization. The influence of the superconductor temperature rise on the magnetization is also calculated. The comparison between measured and calculated magnetization shows good agreement except when the current induction front is very close to the tape edge at the beginning of the application of the field. (auth)

23304 THE USE OF THE ELECTRON MICROSCOPE IN CHECKING THE HEAT TREATMENT OF A HIGH TEMPERATURE Ni-ALLOY. Szabo, O. (Brown, Boveri and Co. Ltd., Baden (Switzerland)). Prakt. Metallog.; 11: No. 9, 525-534(Sep 1974). (In German, English).

Presented at the 1973 Metallography Conference in Iserlohn, F. R. Germany.

Through a knowledge of the processes occurring during solution and precipitation anneals, errors in the heat treatment of Nimonic 105 alloy can be detected using optical and electron microscopy. (auth)

23305 METALLIC CARBIDES IN MODERN MATERIALS TECHNOLOGY. Ruedinger, O. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). Umsch. Wiss. Tech.; 74: No. 20, 629-634(Oct 1974). (In German).

Hard metals are sintered composites of hard metallic carbides and ductile binder metals. The powder-metallurgy and the properties of these materials are discussed. The main fields of application are: tools for metal-forming operations like milling, cold drawing and extrusion, material for protection against wear, mining industry, and tools for machining metals. Carbides are also very important as constituents in ferrous materials especially in high speed steels. (auth)

23306 HIGH-TEMPERATURE DEFORMATION OF AUSTENITIC STAINLESS STEELS CONTAINING TITANIUM. Singhal, L. K. (Tata Electric Locomotive Co., Jamshedpur, India); Mishra, G. L. Metal Sci. J.; 8: No. 12, 427-434(Dec 1974).

A study was made of the elevated-temperature tensile and creep-deformation behavior of an austenitic stainless steel containing Ni_3Ti precipitates. Results were compared with those for a single-phase alloy containing titanium only in solid solution. The yield strength and creep-resistance of the age-hardened alloys initially increase with increasing particle radius and attain maximum values with precipitates of ~100 Å dia. Electron-metallographic examination of underaged specimens reveals dislocation pairs in tensile-tested specimens and single dislocations in specimens tested under creep conditions. Overaged specimens, however, exhibit dislocation loops in both cases. A dynamic glide-recovery model is presented for overaged alloys in which the creep rate is calculated by estimating the rate of shrinkage of dislocation loops around the precipitate particles under the action of an "effective" stress. The predictions of the model for the effects of precipitate size, volume fraction, temperature, and stress-dependence of creep are in qualitative agreement with the experimental observations. The effect of titanium on serrated yielding and subgrain formation is also discussed. (auth)

23307 INVESTIGATION OF STATIC SKIN EFFECT ON ATOMIC PURE (100) AND (110) FACES OF TUNGSTEN SINGLE CRYSTAL. Kharlamov, A. A.; Panchenko, O. A.; Ptushinskii, Y. G. (Inst. of Physics, Kiev). Solid State Commun.; 15: No. 11-12, 1793-1796(15 Dec 1974).

When a Bloch wave is specularly reflected from the metal boundary, several states may appear on different isoenergetic surface sheets. Depending on the shape, Gauss curvature sign, and arrangement of separate sheets of the isoenergetic surface as well as orientation of the crystal physical boundary, such reflections may cause the tangential components of the electron group velocity to reverse after the "mirror" reflection. In W crystals such reflections are realized on the faces (100) and (111) and cannot occur on the (110) face. A comparative investigation of the character of the conduction electron reflection from the atomic pure and oxidized faces (100) and (110) of the tungsten single crystal has been made. The method of static skin effect is used. (auth)

23308 ELECTRICAL RESISTIVITY OF NIOBIUM AND NIOBIUM–ZIRCONIUM ALLOYS. Morton, N.; James, B. W.; Wostenholm, G. H.; Nichols, R. J. (Univ. of Salford, Eng.). J. Phys., F (London); 5: No. 1, 85-92(Jan 1975).

The electrical resistivity of samples of niobium and 75% Nb 25% Zr alloy were measured between the superconducting critical temperatures and room temperature. The temperature dependent component of the resistivity has been compared with phenomenological equations, and it is shown that phonon induced transitions between s and d bands are largely responsible for the observed resistivity. The effect of finite fluctuations of the superconducting order parameter is discussed. (auth)

23309 COMPILATION OF DISLOCATION ENERGY AND ITS DERIVATIVES IN ANISOTROPIC CRYSTALS. Bacon, D. J.; Scattergood, R. O. (Univ. of Liverpool). J. Phys., F (London); 4: No. 12, 2126-2137(Dec 1974).

Calculations were made of the elastic energy, its derivatives with respect to Burgers vector orientation, and the line tension, of infinite straight dislocations in various crystals and different slip systems. A compact compilation of this data was achieved using Fourier expansions, and a tabulation was made such that the energy, its derivatives, and the line tension can be generated from one set of coefficients to a prescribed accuracy. Certain trends in the anisotropic line tension behavior were noted and a classification was made for the crystals considered in this work. While the line tension may differ markedly from isotropy, it appears that the shape of equilibrium shear loops is not very sensitive to these large deviations in the line tension behavior. The metals studied include Be, Cd, Hf, Mo, Nb, Ta, V, Zr. (auth)

23310 STRESS RELIEF CRACKING IN OVERLAY-WELDED COMPONENTS FOR NUCLEAR REACTOR PRESSURE VESSELS OF A HAT-RESISTANT STRUCTURAL STEEL. Lorenz, M.; Luginbuehl, P. (Sulzer Bros. Ltd., Wintherthur, Switzerland). Sulzer Tech. Rev.; No. 1974, 51-60(1974).

Underclad cracking in nuclear reactor pressure vessels has been the subject of lively discussion in recent years. Though many experts in the fields of welding technique and fracture mechanics classify them as rather harmless, these cracks remain unacceptable to those responsible for safe reactor operation as long as their harmlessness is unproven. The paper provides a general definition of the metallurgical terms and a review of the current status. (auth)

23311 ANOMALOUS TEMPERATURE DEPENDENCE OF THE THERMOPOWER IN THE HIGH PRESSURE PHASE OF CERIUM. Ramesh, T. G.; Reshamwala, A. S.; Ramaseshan, S. (National Aeronautical Lab., Bangalore, India). Solid State Commun.; 15: No. 11-12, 1851-1853(15 Dec 1974).

The thermo-electric behavior of cerium in the region lying below and above the critical point for the γ–α transition is reported. The anomalous temperature dependence and the continuous decrease of the thermo-electric power with pressure in the α phase are correlated with the models developed by Blandin et al. and Hirst. (auth)

23312 PULSE CALORIMETRY AND TRANSIENT MEASUREMENT OF THERMAL PROPERTIES AT HIGH TEMPERATURES. Cezairliyan, A. (National Bureau of Standards, Washington, DC). No. 8, 7-17(1974).

From symposium on high temperature studies in chemistry; London (10 Dec 1973).

A system is described for the transient (subsecond) measurement of selected thermal and related properties of electrically-conducting substances in the temperature range 1500°K to the melting point of the specimen. The method is based on resistive self-heating of the specimen from room temperature to any desired high temperature in less than 1 s by the passage of an electrical current pulse through it; and on measuring and recording the experimental quantities every 0.4 ms with a full-scale signal resolution of one part in 8000. The system has been used to measure heat capacity, electrical resistivity, hemispherical total emittance, normal spectral emittance, and the melting point of selected refractory elements and alloys. The results of preliminary experiments have shown the potential application of the system to measurements of temperatures and energies of solid-solid phase transformations and heat of fusion at high temperatures. The materials studied included niobium, molybdenum, tantalum, tungsten, and graphite. (auth)

23313 FRACTURE TOUGHNESS TESTING WITH SECTIONS OF CYLINDERS. Jones, A. T. (Sandia Labs., Livermore, CA). Eng. Fracture Mech.; 6: No. 4, 653-662(Dec 1974).

Finite element procedures were used to generate stress intensity, crack mouth compliance, and load point compliance for a segment from a cylindrical shell. Stress intensity and crack mouth compliance were found to be independent of span length for a large range of crack lengths when suitably normalized. Load point compliance was not truly independent of span length. The experimental procedures developed made it possible to perform tests with ease and reliability. Using both U–Nb alloy and Al specimens, fracture test results showed good correlation with analytical predictions. (auth)

23314 MAGNETIC PROPERTIES OF NEPTUNIUM LAVES PHASES: $NpOs_{2-x}Ru_x$ PSEUDOBINARY SYSTEM. Aldred, A. T.; Lam, D. J.; Harvey, A. R.; Dunlap, B. D. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev., B; 11: No. 3, 1169-1175(1 Feb 1975).

The magnetic properties of the $NpOs_{2-x}Ru_x$ pseudobinary system (C-15 Laves-phase structure) have been investigated by magnetization, resistivity, and nuclear-γ-ray resonance measurements between 1.6 and 300 K. The regular variation of magnetic properties with neptunium–neptunium distance d_{Np} seen in the binary neptunium Laves phases extends into the pseudobinary system. All the compounds studied here appear to order ferromagnetically with a transition temperature ($T_c \leq 5$ K for $x \geq 0.4$) that decreases with an increase in x. The magnetic behavior is interpreted in terms of an increase in delocalization of the magnetic $5f$ electrons as d_{Np} decreases. (auth)

23315 A STUDY OF THE ELECTRICAL RESISTIVITY OF ZONE–REFINED TUNGSTEN AT HIGH TEMPERATURES. Williams, R.K. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Appl. Phys. 46: No. 2, 475-490 (Feb 1975).

The electrical resistivity ρ of a zone–refined tungsten sample (residual resistivity ratio 7×10^4) was determined between 1100 and 2500 K. The error analysis indicates that the data are accurate to about 1%, and comparison of the results with other ρ data indicates that the error analysis may be somewhat pessimistic. The effects of thermionic charge transport on the ρ data and the performance of uninsulated $W_{97}Re_3$:$W_{75}Re_{25}$ thermocouples were also investigated. Comparison of the data with standard transport theory indicates that most of the nonlinear ρ behavior observed at high temperatures is due to thermal expansion effects. (auth)

23316 ELECTRONIC MODEL FOR THE REVERSE ISOTOPE EFFECT IN SUPERCONDUCTING Pd–H(D). Miller, R.J.; Satterthwaite, C.B. (Department of Physics, University of Illinois at Urbana–Champaign, Urbana, Illinois 61801). Phys. Rev. Lett. 34: No. 3, 144-148 (20 Jan 1975).

The large reverse isotope effect in the Pd–H(D) system is confirmed over a range of composition in samples prepared by cathodic charging. It is shown that by shifting the T_c–versus–composition curve for the deuteride by about 0.05 in atomic ratio it can be made to coincide with the data for the hydride. A qualitative explanation is given in terms of proposed differences between the hydride and the deuteride in electronic structure. (auth)

23317 ELECTRON TRANSPORT AND SUPERCONDUCTIVITY IN AMORPHOUS Sb AND ITS ALLOYS. Hauser, J.J. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 11: No. 2, 738-745 (15 Jan 1975).

Amorphous Sb and its alloys are shown to be similar to amorphous Ge from studies of resistivity and electron tunneling. The localization behavior for impurity states in amorphous Sb follows the same general rules as observed for the localization of impurity states in amorphous Ge. Even though crystalline Sb is a semimetal, amorphous Sb is found to be a semiconductor with properties similar to the amorphous tetrahedrally bonded semiconductors. (auth)

23318 TUNNELING STUDY OF IMPURITY BANDS IN KONDO SUPERCONDUCTING SYSTEMS: Cu ALLOYS BACKED BY Pb. Dumoulin, L.; Guyon, E.; Nedellec, P. (Laboratoire de Physique des Solides, Université Paris Sud, 91405 Orsay, France). Phys. Rev. Lett. 34: No. 5, 264-267 (3 Feb 1975).

We present tunneling experiments on Cu:X (X stands for Cr, Fe, or Mn) thin alloy films in superconducting proximity with Pb. For cases of Cr and Mn, with Kondo temperatures T_K lower than the critical temperature T_c, we observe an impurity band inside the quasi-BCS gap, in agreement with theoretical predictions. Our results on Cu:Fe ($T_K/T_c \sim 5$) do not show such structure and disagree with theory. (auth)

23319 ANALYSIS OF SURFACE LAYERS BY THE CHANNELING TECHNIQUE: BEAM ENERGY DEPENDENCE. Della Mea, G.; Drigo, A.V.; Lo Russo, S.; Mazzoldi, P.; Yamaguchi, S. (Istituto di Fisica dell'Università, Unità del Gruppo Nazionale di Struttura della Materia, Padova, Italy); Bentini, G.G. Appl. Phys. Lett. 26: No. 4, 147-150 (15 Feb 1975).

The surface peak of the channeling energy spectrum has been investigated as a function of energy of the incident beam. An increase of the surface peak value with energy has been observed for axial channeling in silicon ⟨110⟩, germanium ⟨111⟩, molybdenum ⟨111⟩, and vanadium ⟨100⟩ and ⟨110⟩ crystals with low surface contamination. The influence of oxide layers on the energy dependence effect has been investigated on silicon crystals. (auth)

23320 METAL REFLECTIVITY UNDER HIGH-INTENSITY OPTICAL RADIATION. Zavecz, T.E.; Saifi, M.A. (Western Electric Company, Incorporated, Engineering Research Center, P. O. Box 900, Princeton, New Jersey 08540); Notis, M. Appl. Phys. Lett. 26: No. 4, 165-168 (15 Feb 1975).

Single high-intensity (10^6-10^9 W/cm^2) pulses of 1.06-μ radiation emitted from a Q-switched Nd : YAG laser have been used to study reflectivity behavior of single-crystal copper and tantalum samples. Metal reflectivity during irradiation undergoes a significant drop to values much lower than can be attributed to high-temperature effects. This reflectivity drop under high radiation intensity has two characteristic features. First, if vaporization is avoided, then during the rising portion of the laser pulse the reflectivity drops continuously until it reaches a constant low value. For copper this occurs at an intensity of 3×10^8 W/cm^2 and has a reflectivity value of $\simeq$0.64. The corresponding values for tantalum are $I\simeq2.5\times10^7$ W/cm^2 and $R\simeq$0.41. For still higher intensities a further drop in reflectivity beyond the plateau region is observed. This drop in reflectivity is always accompanied by heavy melting and followed by some vaporization. As suggested by Prokhorov *et al.* this further drop in reflectivity could be associated with dielectriclike behavior of the molten zone. (auth)

23321 FIELD DESORPTION OF HELIUM AND NEON FROM TUNGSTEN AND IRIDUM. Panitz, J.A. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Vac. Sci. Technol. 12: No. 1, 210-212 (Jan 1975).

The first complete crystallographic distribution of helium and neon field adsorbed on tungsten and iridium surfaces has been determined using field desorption mass spectromatry. At 80 K He^+ is removed from tungsten at high work function areas. The absence of He^+ in other regions indicates that either helium is not adsorbed, or that it is removed from the surface as a WHe^{3+} molecular ion during field evaporation of the substrate, which is required for He^+ detection. Helium adsorbed on iridium at 80 K may form $IrHe^{3+}$ and neon $IrNe^{2+}$ near prominent zone lines. The absence of ion species in specific crystallographic regions of iridium and tungsten suggests care when interpreting atom probe results in certain metallurgical applications. (auth)

23322 THE ATOMIC ARRANGEMENT IN THE 1×1 STRUCTURE OF A SILICON-ORDERED MONOLAYER ON Mo{001}. Ignatiev, A.; Jona, F. (Department of Materials Science, State University of New York, Stony Brook, New York 11794); Jepsen, D.W.; Marcus, P.M. J. Vac. Sci. Technol. 12: No. 1, 226-229 (Jan 1975).

The reaction of a clean Mo{001} surface with Si vapor was studied with low-energy electron diffraction (LEED) and Auger electron spectroscopy (AES). For an apparent coverage of one monolayer of Si atoms, the symmetry and the periodicity of the surface structure are the same as for the clean surface; this structure is therefore conventionally designated Mo{001} 1×1-Si. An analysis of the intensities of the diffracted beams reveals that the Si atoms are adsorbed in the fourfold coordinated pyramidal hollows formed by four adjacent Mo atoms on the {001} surface. The distance between the plane of adsorbed Si atoms and that of the top layer of Mo atoms is 1.16±0.1 Å. (auth)

23323 ANGULAR DEPENDENCE OF UV PHOTOELECTRON DISTRIBUTIONS FOR OXYGEN ADSORBED ON W(100). Waclawski, B.J.; Vorburger, T.V.; Stein, R.J. (National Bureau of Standards, Washington, D.C. 20234). J. Vac. Sci. Technol. 12: No. 1, 301-304 (Jan 1975).

Recent theoretical work has suggested the possibility of determining chemisorption bond geometry by the use of uv photoemission. This possibility is being investigated experimentally in an apparatus developed at NBS. The apparatus is described, and preliminary results are presented which show energy distributions as a function of emission angle for electrons photoemitted from W(100), both clean and with adsorbed oxygen. The results obtained at $h\nu$ = 21.2 eV for several emission angles indicate substantial angular dependence of the photoelectron distributions, not only for the clean (100) surface, but also, more dramatically, with an oxygen adlayer. (auth)

23324 INVESTIGATIONS OF ADSORPTION ON METAL SURFACES BY PHOTOELECTRON SPECTROSCOPY, COMBINED WITH OTHER METHODS. Menzel, D. (Physik-Department, Technische Universität München, 8046 Garching, Germany). J. Vac. Sci. Technol. 12: No. 1, 313-320 (Jan 1975).

A survey is given of the experimental information which can be obtained for adsorbate layers on metals by photoelectron spectroscopy (valence level spectroscopy by UPS, quantitative analysis, and chemical shifts of adsorbate and substrate core levels by XPS), and of the difficulties arising in their interpretation. Three levels of interpretation are distinguished: a qualitative approach using the UPS and XPS spectra as fingerprints, which works best in correlation with other methods, a semiquantitative approach which tries to extract physical insight from the measured data on an intermediate level of sophistication, and as the ultimate aim, a correlation of photoelectron spectra with the spectral density obtained from many-body theories. As examples for the first approach, results for the adsorption of CO on Ru(001) and W(110), and of oxygen on W(100) are described and discussed. (auth)

23325 CHEMICAL EFFECTS IN THE $M_{4,5}NN$ AUGER SPECTRUM OF Mo(110) DUE TO ADSORPTION OF O_2 AND CO. Hooker, M.P.; Grant, J.T. (Universal Energy Systems, Inc., Medway, Ohio 45341); Haas, T.W. J. Vac. Sci. Technol. 12: No. 1, 325-328 (Jan 1975).

Chemical effects are observed in the $M_{4,5}NN$ Auger spectrum of Mo following adsorption of oxygen and carbon monoxide on clean Mo(110). This system is particularly interesting as Auger transitions involving only core electrons, one conduction band electron or two conduction band electrons are all present over the energy range 90-250 eV. On adsorption, Auger transitions involving only core electrons shift to lower energies, whereas those involving one or two conduction band electrons undergo changes in shape. Auger spectra are presented in both derivative form $N^{(1)}_m(E)$ and following integration, $N_m(E)$. (auth)

23326 AUGER-ELECTRON SPECTROSCOPY OF HIGH-TEMPERATURE OXYGEN-RHENIUM INTERACTIONS BY AES. Weber, B.; Bigeard, B.; Mihe, J.P.; Cassuto, A. (Centre de Cinétique Physique et Chimique du CNRS, Route de Vandoeuvre, 54600 Villers-Nancy, France). J. Vac. Sci. Technol. 12: No. 1, 338-340 (Jan 1975).

Oxygen coverage θ has been measured on a rhenium ribbon, in a wide temperature range (300-2200 K), with a CMA, while monitoring the oxygen pressure ($10^{-9}-10^{-6}$ Torr) and the rhenium trioxide formation with a quadrupole mass spectrometer. Under 5% coverage, θ vs p curves are linear, in agreement with an atomization reaction as the main process. Isotherm plots lead to a rhenium-oxygen atomic binding energy of 125 kcal/g atom at low coverage, while the trioxide flux indicates at higher coverage a surface reaction process, with a rate proportional to θ^3 and a linear decrease of the atomic binding energy, $\chi = (125 - 25\,\theta)$ kcal/atom. The results are in close agreement with those previously obtained, according to a general interaction model of oxygen with transition metals. (auth)

23327 PROPERTIES OF SPUTTERED HIGH T_c THIN FILMS. Gavaler, J.R. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Vac. Sci. Technol. 12: No. 1, 103-106 (Jan 1975).

Of all of the presently known superconducting materials, only a few have critical temperatures (T_c) of 15 K or higher. We have been investigating the properties of sputtered thin films of several of these highest T_c materials, including Nb_3Ge, NbN, Mo-Re, Nb-Sn, and Nb-Ga, among others. It has been found that these films occasionally have enhanced T_c compared to bulk samples. Most notable of these are Nb_3Ge films which have the highest presently known T_c (~23 K). In addition, the sputtered films often exhibit superior current and magnetic field characteristics. All of these thin film results are reviewed together with x-ray and electron microscope results, which indicate that the enhanced properties of the films are due to both structural and compositional differences between thin film and bulk samples. (auth)

23328 APPLICATIONS OF DEPTH PROFILING BY AUGER/SPUTTER TECHNIQUES. Holloway, D.M. (General Electric Company, Neutron Devices Department, P.O. Box 11508, St. Petersburg, Florida 33733). J. Vac. Sci. Technol. 12: No. 1, 392-399 (Jan 1975).

Auger electron spectroscopy combined with inert-gas ion bombardment is one of the accepted techniques for obtaining information regarding the depth distribution of elemental species in a variety of materials. The intent of this paper is to discuss in some detail the depth-profiling technique combining Auger electron spectroscopy and inert-gas ion bombardment. Special attention will be given to the basic considerations, problems, and limitations of the technique as well as the qualitative and quantitative information that

may be obtained. Several applications of the technique will be presented for a variety of materials to demonstrate the wide-range application and practical utility of this method for depth profiling. (auth)

23329 THE METALLOGRAPHY OF THE RARE EARTH-COBALT ALLOYS. P. 2. Metallographic Preparation of Rare Earth Metals and Rare Earth-Cobalt Alloys. Herget, C.; Altenhoff, H. (Goldschmidt (Th.) A. G., Essen (F. R. Germany). Metall-Labor). Prakt. Metallog.; 11: No. 10, 599-612(Oct 1974). (In German, English).

11 figs.; 21 refs.

With the aid of certain special techniques such as the Kerr effect, metallography is an essential method for the quality control of and research into the rare earth metals and rare earth-cobalt alloys. It must however be supplemented by a very efficient chemical analysis. Practical techniques for the production of metallographic sections of rare earth metals and rare earth metal alloys are described and examples given of their use. (auth)

23330 EFFECT OF ZIRCONIUM ON THE HEAT STRENGTH OF TITANIUM-ALUMINUM ALLOYS. Kornilova, Z. I.; Lazarev, E. M.; Ignatov, D. V.; Popova, V. M. Izv. Akad. Nauk SSSR, Metal.; No. 5, 226-231(1974). (In Russian).

Alloying Ti-Al alloys with zirconium (5 wt %) increases the heat strength at 800°C (the rate of oxidation is decreased by a factor of 2 to 2.5) as a result of strengthening the multi-component, solid solution of α-titanium. At temperatures of the polymorphic transformation and higher, zirconium has a negative effect on the heat strength of Ti-Al alloys by disintegrating the rutile lattice and making it more penetrable to oxygen diffusion. (SJR)

23331 X RAY STUDY OF THE LIQUID, EUTECTIC ALLOY Zn-Cd-Sn. Dutchak, Ya. I.; Frenchko, V. S.; Voznyak, O. M. Izv. Akad. Nauk SSSR, Metal.; No. 5, 232-234(1974). (In Russian).

By x ray diffractometry a study is carried out of near order in a ternary eutectic alloy of Zn-Cd-Sn. Curves were obtained for the intensity of scattered x rays, and atomic distribution functions were calculated at temperatures of 431, 441, 463, 518, 596, and 699°K. In interpreting the curves for the radial distribution of atoms, use was made of model concepts of the near-order structure. (SJR)

23332 PHASE EQUILIBRIA AND STRUCTURE OF THE ALLOYS Fe-TiB_2, Fe-ZrB_2, AND Fe-HfB_2. Shurin, A. K.; Panarin, V. E. Izv. Akad. Nauk SSSR, Metal.; No. 5, 235-239 (1974). (In Russian).

The alloy systems Fe-TiB_2, Fe-ZrB_2 and Fe-HfB_2 are quasibinary cuts of the corresponding ternary phase diagrams, and have a eutectic character. A determination was made of the melting temperatures and temperatures of phase transformations in the solid state for alloys of these systems. By means of electron and optical microscopy a study was made of the morphology of cast alloys which indicates that the eutectic structure is colonial and that the diborides play a leading role as nuclei during eutectic crystallization. (SJR)

23333 STRUCTURE OF SOLID SOLUTION CRYSTALS OF $Cd_xHg_{1-x}Te$ OBTAINED FROM A MELT. Boinykh, N. M.; Sokolov, A. M.; Indenbaum, G. V.; Vanyukov, A. V. Izv. Akad. Nauk SSSR, Metal.; No. 5, 240-242(1974). (In Russian).

Etching agents are proposed for developing dislocations on planes of different orientation in solid solution crystals of $Cd_{0.2-0.24}Hg_{0.8-0.76}Te$. By means of etching a study was made of the density and distribution of dislocations, and also of the separation of a second phase in crystals grown from a melt in quartz ampules by the Bridgeman-Stockbarger method at different rates. On an x-ray, two-crystal spectrometer, measurements were carried out on the disorientation of unit blocks. The dependence of the substructure was established as a function of crystallization rate and ampule diameter. (SJR)

23334 BRITTLENESS OF Cr-Ni-Co-Mo STEELS. Shakhnazarov, Yu. V.; Vorob'eva, N. I.; Shul'man, V. M. Izv. Akad. Nauk SSSR, Metal.; No. 5, 165-168(1974). (In Russian).

A study of cast steel showed that the absence of brittleness in the unquenched (or quenched from a temperature less than ~850°C) state is not connected with the desirable effect of plastic deformation. Brittleness after high-temperature (>850°C) quenching is caused by recrystallization of austenite, is accompanied by a change in angle of disorientation of initial and new layers of martensite, and manifests itself after aging. On the basis of an analysis of dilatograms the separation of phases rich in cobalt during aging is proposed. Nickel activates the separation of molybdenum during high-temperature aging (420 to 520°C). A method of decreasing "quench" brittleness is proposed and investigated. With the presence of residual austenite in the structure there is an increase in viscosity, resistance to crack development and low-cyclic fatigue, and a decrease in short-time strength at 600°C and fatigue limit. (SJR)

23335 DECOMPOSITION OF METASTABLE PHASES IN THE TITANIUM ALLOY VTZ-1. Ivanov, A. S.; Tomsinskii, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 5, 173-179(1974). (In Russian).

On heating quenched alloy VTZ-1 with a $\alpha + \alpha'' + \beta$ structure a transition is observed $\alpha'' \rightarrow \beta$ which goes by way of an intermediate conversion and is complete at temperatures of 150 to 200°C. During heating the formation of two types of β-phase is observed with increased and lowered concentrations of alloying elements (Mo, Cr). Decomposition of a metastable β-phase goes with formation of an intermediate α-phase in the temperature interval of 300 to 400°C. In the process of heating an alloy having a $\alpha + \alpha'' + \beta$ composition after quenching from 900°C, disappearance of the α''-phase is observed at low temperatures (as low as 150°C). In an alloy having a $\alpha + \alpha'' + \beta$ composition after quenching from 920°C, conversion of a metastable β-phase to an α''-phase is observed on heating to a temperature of 200°C. On heating an alloy having a $\alpha + \alpha''$ structure after quenching from 940°C, intensive decomposition of a metastable α''-phase begins only at 250°C, and is complete at 450 to 500°C with the formation of α- and β-phases close to equilibrium values in composition. (SJR)

23336 STUDY OF THE EARLY STAGES OF THERMAL FATIGUE IN SINGLE CRYSTALS OF MOLYBDENUM AND TUNGSTEN. Krakhmalev, V. A.; Klein, G. A. Izv. Akad. Nauk SSSR, Metal.; No. 5, 204-207(1974). (In Russian).

From changes in the properties and crystal structure of single-crystal tungsten and molybdenum during cyclic thermal testing it is possible to infer particular dislocation rearrangements which take place in crystals as a result of processes of decarburization, migration and erosion of initial subgrains, and intensive multiplication of dislocations and their annihilation. One of the main causes of a fatigue substructure formation in single crystals during thermal cycling is the occurrence of processes of polygonization. Coarsening of the structure and gradual conversion of single crystal to polycrystalline material take place simultaneously by disorientation of elements of the polygonal substructure, and by the occurrence of polycrystalline grain nuclei in sites of large dislocation glide. (SJR)

23337 INTERACTION OF DISPERSED OXIDE INCLUSIONS WITH CHROMIUM METAL. Kaputkin, E. Ya.; Kenigfest, A. M.; Mozzhukhin, E. I.; Rakovskii, V. S.; Khodkin, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 5, 159-164(1974). (In Russian).

From the degree of interaction with a chromium matrix at relatively low temperatures (1000°K), oxides are arranged (in decreasing order) in the following series: $MgCr_2O_4$, Al_2O_3, MgO, and ZrO_2, and at high temperatures (2000°K), in the following succession: MgO, $MgCr_2O_4$, Al_2O_3, and ZrO_2. An atmosphere which changes the position of oxides in the series has a substantial effect on the interaction of the oxides with a chromium matrix. In this case with decreasing concentration of metal forming a dispersed oxide in the matrix, the oxides are arranged in the following order: at a temperature of 1000°K-MgO, Al_2O_3, ZrO_3, and $MgCr_2O_4$, and at a temperature of 2000°K-$MgCr_2O_4$, MgO, Al_2O_3, and ZrO_2. At relatively low temperatures the interaction between matrix and oxide, which is characterized by the content of metal of the dispersed oxide in the chromium matrix, is significantly less in a reducing atmosphere than under conditions of the absence of the effect of an atmosphere. Decreasing the content of moisture in the hydrogen leads to an increase in the interaction of the oxides with the chromium matrix. (SJR)

23338 SELF-DIFFUSION IN In-Cd MELTS. Yakushevskii, S. Yu.; Khar'kov, E. I.; Onoprienko, G. I.; Alimova, R. F. Izv. Akad. Nauk SSSR, Metal.; No. 5, 88-89(1974). (In Russian).

Because of the absence of any detailed features in the concentration dependence of the self-diffusion coefficients of components in the In-Cd system it is possible to conclude that in this system the microinhomogeneities in the liquid alloys are either weakly expressed or are totally absent. (SJR)

23339 ENTHALPY OF FORMATION OF LIQUID ALLOYS OF ALUMINUM CONTAINING TITANIUM AND ZIRCONIUM. Esin, Yu. O.; Bobrov, N. P.; Petrushevskii, M. S.; Gel'd, P. V. Izv. Akad. Nauk SSSR, Metal.; No. 5, 104-109(1974). (In Russian).

Calorimetric studies of the partial molar enthalpies of formation ($\overline{\Delta H}_i$) were carried out on liquid alloys of aluminum containing titanium and zirconium, and also calculations were made on the integral heats of formation and changes in the energies of the interatomic reactions with composition of the solutions. (SJR)

23340 THERMODYNAMIC PROPERTIES OF THORIUM MELTS CONTAINING BISMUTH. Poyarkov, A. M.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 5, 118-121(1974). (In Russian).

By making emf measurements thermodynamic characteristics were established for Th–Bi solutions and the compound Th_3Bi_4. The solubility of thorium in molten bismuth was also determined. It was found that 0.82 and 2.01 at.% Th dissolves in bismuth at 1000 and 1100°K. (SJR)

23341 EFFECT OF OXYGEN ON THE DISSOCIATION PRESSURE IN THE Y–H SYSTEM. Fadeev, V. N.; Izhvanov, L. A.; Chernikov, A. S. Izv. Akad. Nauk SSSR, Metal.; No. 5, 85-87(1974). (In Russian).

Oxygen within the limits of its solubility in α-Y increases the equilibrium pressure of hydrogen over yttrium hydride. The role of oxygen at a content greater than the solubility limit consists in binding yttrium as Y_2O_3 and removing it from reacting with hydrogen. An estimate of the effect of oxygen on the dissociation pressure of yttrium hydride must be carried out with the phase diagram of Y–O system being taken into account. (SJR)

23342 SOLUBILITY OF HYDROGEN IN LIQUID ZIRCONIUM. Lakomskii, V. I.; Grigorenko, G. M.; Korzhov, M. P.; Solomentsev, A. N. Izv. Akad. Nauk SSSR, Metal.; No. 5, 69-72(1974). (In Russian).

The solubility of hydrogen in zirconium was investigated experimentally, and was found to obey a square root law. An analytical expression is obtained for the solubility of hydrogen in zirconium as a function of temperature, and an expression is obtained for determining the partial, molar, free energy of mixing. The partial standard entropy of hydrogen dissolved in zirconium is determined. (SJR)

23343 ON THE SURFACE DIFFUSION SHARE IN THE EFFUSION OF SILVER OUT OF TANTALUM CELLS. Hirschwald, W.; Neumann, G.; Hildebrandt, M. (Freie Univ. Berlin (F. R. Germany). Inst. fuer Physikalische Chemie und Quantenchemie). Z. Phys. Chem. (Frankfurt); 84: No. 1/4, 43-54(Mar 1973). (In German).

The Knudsen method normally used for vapour pressure measuring is tested for its suitability in the determination of surface diffusion coefficients. The tantalum/silver observed effects in the system are relatively small. By means of approximation calculations for the desorption and diffusion energy of silver on tantalum, $D^*_{(s,)} \leq 10^{-3}$ [cm²/sec] is obtained as upper limit for the frequency factor of the diffusion which principally agrees with the field electron microscopic investigations. (GE)

23344 ELECTRON STRUCTURE OF ALLOYS IN THE Mo–Re SYSTEM BY THE X-RAY SPECTROSCOPY METHOD. Shabalovskaya, S. A.; Panin, V. E.; Tymentseva, S. F.; Freze, N. I. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 119-123(1974). (In Russian).

The $L\beta_1$ bands of Mo in alloys of the Mo–Re system were studied. On the basis of experimental results and literature data, an analysis was made of the change of the electron structure of Mo during its alloying with Re. The existence of a clear step-wise change of the parameters of the electron structure, the heats of solution of inclusions (hydrogen), and the lattice parameters with the increase of the Re concentration in the alloy were shown. The nature of the step-wise change was discussed. (tr-auth)

23345 EFFECT OF THE STRUCTURE OF TUNGSTEN–RHENIUM SOLID SOLUTIONS ON THE NPR SPECTRUM OF IRON-57 IMPURITIES. Budagovskii, S. S.; Bykov, V. N.; Gavrilyuk, M. I.; Ivanyushkin, E. M.; Rudnev, I. I. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 7-12(1974). (In Russian).

The effect of the structure of solid solutions of the W–Re system with Re concentrations up to 27 at. % on the NPR spectrum of ^{57}Fe impurity nuclei was studied. ^{57}Co (parent element of ^{57}Fe) was introduced into the alloy system by diffusion annealing. It was shown that as a result of the diffusion annealing at 1080°C for 16 h the Co diffuses preferentially to defects of the crystalline lattice (dislocations and grain boundaries). It was established that in the alloys studied a region with an electron structure different from the electron structure of the solid solution matrix is formed at the defects. The type of electron structure of this region and its quantity are a complex function of the composition of the alloy and its structure. The results of the measurement of the NPR spectrum of ^{57}Fe in W, Re, σ phase, and alloys with a two-phase region were also reported. (tr-auth)

23346 EFFECT OF 42Kh2GSNMA STEEL ALLOYING WITH TUNGSTEN, MOLYBDENUM, COPPER, AND COBALT ON THE IMPACT STRENGTH OF WELDED JOINTS. Laz'ko, V. E.; Yarovinskij, Yu. L. Svar. Proizv.; No. 2, 22-23(Feb 1974). (In Russian).

For English translation see the journal Weld. Prod.

It was established that additional alloying of steel 42Kh2GSNMA with tungsten and molybdenum decreases, while alloying with copper and cobalt (up to 3%) increases the impact strength and bend plasticity of the base metal and seam metal at room-temperature testing. The cold resistance of the base metal and seam metal increases on adding copper up to 1.4% and cobalt up to 2.4%, and decreases on alloying with molybdenum and tungsten. However, some increase in the cold resistance of seam metal is noted on adding tungsten up to 1%. It was established that the different effect of alloying elements on the properties of the base metal and seam metal was caused by the specific action of these elements on the size of the martensitic crystals and the degree of homogeneity of carbon distribution in the seam metal. (tr-auth)

23347 INHOMOGENEITY OF THE STRUCTURE AND PROPERTIES OF MOLYBDENUM ALLOY WELDED JOINTS. Nerodenko, M. M.; Gurevich, S. M.; Alekseenko, G. N.; Galinzovskaya, T. D. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki); Lizunov, V. A.; Minakov, V. N.; Trefilov, V. I.; Kaverina, S. N. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki). Avtomat. Svarka; No. 6, 19-22(Jun 1974). (In Russian).

For English translation see the journal Autom. Weld.

The basic reasons for the inhomogeneity in structure and properties of welded molybdenum alloys are considered. It was determined that the inhomogeneity is determined by surface sheet contamination, by a inhomogeneous distribution of lattice impurities, by the amount of impurity, by the state of the solid solution, and by features in the formation of seam structure. (tr-auth)

23348 STRUCTURE AND PROPERTIES OF JOINTS MADE BY ELECTROSLAG WELDING OF TITANIUM BASE ALLOYS OF THE Ti–6Al–6Zr–6V–2Sn AND Ti–5Al–4Mo–5Zr–1Cu SYSTEMS. Grabin, V. F.; Kompan, Ya. Yu.; Gurevich, S. M.; Novikova, D. P.; Potapenko, L. A.; Matveenko, A. F. Svar. Proizv.; No. 5, 20-22(May 1974). (In Russian).

For English translation see the journal Weld. Prod.

A welding rod SV-10Kh2M was developed for electroslag, automatic welding under flux, that assures strength properties and impact strength of the welded joints from steel 12 khM after repeated thermal treatment. This rod meets the requirements of the technology of making thick-walled equipment. The rod has the following chemical composition: 0.08 to 0.14% C; 0.4 to 0.7% Mn; 0.17 to 0.37% Si; 1.3 to 1.7% Cr; 0.4 to 0.6% Mo; .01 to 0.2% rare earth oxides; rest-iron. The iron assures an impact strength of metal in the seam at a temperature of –40°C that is not lower than 3 kgs · m/cm². It can be shown by calculation that use of this welding rod in factories making thick-walled equipment will result in savings of at least 30,000 rubles per year. (tr-INIS)

23349 NUCLEAR-ACOUSTIC-RESONANCE DETERMINATION OF THE GRADIENT-ELASTIC TENSOR AND INDIRECT NUCLEAR-SPIN INTERACTIONS IN NIOBIUM. Pellisson, J.; Buttet, J. (Univ., Geneva). Phys. Rev., B; 11: No. 1, 48-59(1 Jan 1975).

Nuclear-acoustic-resonance studies of the absolute intensity of the signals and of the angular dependence of their second moments were made in single crystals of niobium for the electric quadrupole transitions $\Delta m = \pm 1$ and $\Delta m = \pm 2$ as well as for the $\Delta m = \pm 1$ magnetic dipole transition. From the intensity measurements, the two independent coefficients of the electric field gradient elastic strain tensor are $|S_{11} - S_{12}| = 1.2 \times 10^{16}$ and $|S_{44}| = 2.25 \times 10^{16}$ statcoulomb cm^{-3}. From the second-moment data, the indirect effective spin Hamiltonian is the sum of an exchange and dipolar term. The pseudodipolar coefficients for the first and second nearest neighbors are equal to $B_1 = 180$ or -800 Hz and $B_2 = 0$ or -400 Hz. The pseudoexchange coefficients A_{ij} are such that $\Sigma_j A_{ij}^2 = 1.14$ kHz^2 corresponding to a first-nearest-neighbor coefficient $A_1 \simeq 300$ Hz. The contribution to the second moment of the indirect electric quadrupole spin Hamiltonian is also evaluated. (auth)

23350 MAGNETOCRYSTALLINE ANISOTROPY OF $SmCo_5$ AND ITS INTERPRETATION ON A CRYSTAL-FIELD MODEL. Sankar, S. G.; Rao, V. U. S.; Segal, E.; Wallace, W. E. (Univ. of Pittsburgh). Phys. Rev., B; 11: No. 1, 435-439(1 Jan 1975).

Results of magnetization measurements on carefully prepared single crystals of $SmCo_5$ are presented over the temperature range 4–970°K. The contribution of the rare-earth sublattice magnetocrystalline anisotropy was evaluated using the data on YCo_5 as "a blank." These results are interpreted on the basis of a single-ion model. The following Hamiltonians were employed to obtain eigenvalues: $\mathcal{H}$(parallel to c axis) = $\lambda \vec{L} \cdot \vec{S}$ + $\mathcal{H}_{CF}$ + $2\mu_B S_z H_{ex}$, $\mathcal{H}$(perpendicular to c axis) = $\lambda \vec{L} \cdot \vec{S}$ + $\mathcal{H}_{CF}$ + $2\mu_B S_x H_{ex}$. H_{ex} was regarded as arising mainly from the cobalt sublattice. Contributions arising from the multiplets $^6H_{\frac{9}{2}}$ and $^6H_{\frac{7}{2}}$ to the ground multiplet $^6H_{\frac{5}{2}}$ were included. The crystal field was evaluated in terms of Racah's tensor-operator technique employing 3-j and 6-j symbols. With the two sets of eigenvalues obtained from the above expressions, the anisotropy energy to

rotate the magnetization direction from the axis to the plane was calculated and compared with experimental results on single crystals of $SmCo_5$. It is shown that the sign of the crystal-field parameter predicts the correct easy direction of magnetization and that the free-energy values calculated from 4 to 970°K are in reasonable agreement with experiment. (auth)

23351 LOW-TEMPERATURE RESISTIVITY OF Yb IN Au, Ag, AND Au–Ag ALLOYS. Talmor, Y.; Sierro, J. (Matiere Condensee, Geneva). Phys. Rev., B; 11: No. 1, 300-308(1 Jan 1975).

Resistivity measurements on $(Au_x Ag_{100-x})_{100-y} Yb_y$ which cover the concentration ranges $x = 0$ to 100 at.% and $y = 0$ to 2 at.%. The resistivity minima observed are found to be a combination of two mechanisms, which can be separated only by a suitable heat treatment. The first effect is due to the Yb behaving as a solid solution and is explained in terms of the shift of the Fermi level as the host's composition is varied. The second effect results form the presence of intermetallic phases inside the matrix, essentially $YbAu_3$. Of these two mechanisms, that due to the intermetallic phase dominates. The resistivity of some intermetallic compounds $YbAu_x$ was also measured and found to show resistivity minima larger than any of those observed in the (AuAg)Yb system. (10 fig.) (auth)

Radiation Effects

Refer also to abstracts 22333, 22335, 22339, and 23188.

23352 (AD-786578) GAMMA-IRRADIATION DAMAGE IN AGE HARDENING Al ALLOYS. Final Report. Fiore, N. F. (Notre Dame Univ., Ind. (USA)). Jul 1974. Contract DAAD05-70-C-0085. 43p. (BRL-CR-167). NTIS $3.75.

Pure Al and a series of age-hardenable Al alloys have been gamma-irradiated in a ^{60}Co source at a dose of 6000 rads/min. Internal friction measurements have been made at 80 kHz by means of the Marx technique on samples in situ during irradiation. In Al and Al–3 wt % Cu, the damping decreases monotonically as is expected. The decrease is attributed to the immobilization of dislocations by the radiation-induced point defect pinners. In 2024-T6, 2017-T6, and Al–9.5 Mg, the damping passes through a minimum and begins an anomolous increase after 4 to 7 hours of irradiation. In the alloys which display the damping minimum, precipitate morphology changes during irradiation, with coarsening and/or de-coarsening and re-nucleation being observed. The effect appears to depend upon the presence of Mg. Theory predicts that morphology changes can occur during gamma-irradiation, with the mechanism being either Rutherford collision or coulombic repulsion radiation damage. (GRA)

23353 (AD-786733) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Semiannual Progress Report, 1 February–31 July 1974. Steele, L. E. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 72p. (NRL-MR-2875). NTIS $4.25.

The research program of the NRL metallurgy division, reactor materials branch, involves a broad study of the effects of nuclear radiation upon materials. The report includes: (1) status and recent observations of AEC-CE-NRL cooperative program on improved (radiation resistant) A533-B steel plates and weldments; (2) strength and notch ductility of selected structural alloys after high fluence, 550°F irradiation; (3) toughness of irradiated type 316 weld metal using the J-integral, (4) Microstructure and swelling of EBR-II control rod thimble material; (5) The dose dependence of nickel ion damage in nickel; (6) Studies of the mobility of helium in 316 stainless steel and aluminum, and (7) evaluation of tensile specimens from surveillance capsules of MH-1A reactor. (GRA)

23354 (AED-CONF-74-328-027) POINT DEFECT AND DISLOCATION INTERACTION IN ELECTRON IRRADIATED TELLURIUM. Saffert, R.; Landwehr, G.; Gmelin, E. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). 1974. 9p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

Low-temperature irradiation experiments of tellurium single crystals with 1 MeV electrons reveal at least three annealing stages at 50, 110, and 140°K. The dose dependence of the measured quantities: electrical resistivity, Hall, Seebeck, and Nernst-Ettingshausen coefficient is anisotropic. In the orientation $j \| c$ the carrier mobility is initially increased by irradiation. This effect is explained by the presence of dislocations. A model based on the interaction of point defects with dislocations is proposed which can explain all irradiation experiments at least qualitatively. The dose dependence of carrier concentration and mobility can be described quantitatively. (auth)

23355 (AERE-TP-375) KINETICS OF VOID GROWTH DURING NEUTRON IRRADIATION. Bullough, R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Aug 1969. 8p. (HL-69/4007). Dep. NTIS (US Sales Only) $4.00.

Asymptotic swelling behavior in solids was studied. It was concluded that the ultimate swelling rate can be decreased by increasing the value of the vacancy self diffusion constant D_s^v, where D_s^v is the vacancy self diffusion energy, and by reducing the net defect production rate. These conclusions must be regarded as preliminary since the quantitative effects of recombination have not yet been included. It is assumed that the majority of defects are lost at the dislocations and by recombination. (auth)

23356 (CEA-CONF-2734) REACTOR SWELLING OF PURE METALS. Levy, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). 1974. 27p. (CONF-740956-2). Dep. NTIS (US Sales Only) $4.50.

From symposium on the physics of irradiation produced voids; Harwell, UK (9 Sep 1974).

The fundamental processes involved in formation of radiation induced voids were investigated. Methods of testing void formation models were also studied along with methods of establishing reliable correlations between swelling induced by neutron, ion, or electron bombardment. Information and discussions are included on void nucleation, void growth, dislocation structures, and impurity effects. (JRD)

23357 (JUL-1006-FF) STUDYING THE DEFECT PRODUCTION IN ELECTRON-IRRADIATED GOLD ALLOYS IN THE TEMPERATURE REGION 8°K–153°K. Heidrich, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (F. R. Germany)). Oct 1973. 108p. (In German). INIS.

The problem of the very free mobility of the interstitials by measuring the defect rate at electron energies between 1.4 MeV and 3.0 MeV for various diluted gold alloys was investigated in the temperature range of 8°K to 153°K and defect concentrations about 1×10^{-4}. The irradiation of the alloys resulted in a higher initial defect rate as compared with the irradiation of pure gold. The measured defect rate curves showed a smaller dependence of the defect rate on the defect concentration for the alloys than for pure gold. Investigation of the temperature dependence of the defect rate with that alloy Au + 405 ppM Mg showed that the dependence of the defect rate on the impurity concentration decreases with higher temperature. The investigation of the initial defect rate of pure gold and Au + 137 ppM Al showed that with decreasing energy, the ratio of the initial defect rate of the alloy to that of pure gold tends to 1. The temperature dependence found for the initial defect rate leads within the framework of the model of the three-dimensional diffused interstitials to a physically hard to understand increase of the trap radii with temperature. The dependence for the defect rate of the radiation-induced defect concentration does not agree with model predictions. The temperature dependence of the initial defect rate can be explained with one-dimensional diffusion of the interstitials by a temperature dependence on Σ_{r_0}/Σ_v. The mathematical adaptation gives plausible values for the relative effective cross-section of the interaction of the interstitials with impurities related to that of the interaction of vacancies. For the dislocation distance of the interstitials, the adaptations had a value of $r_p = 60\ a_0$ lattice constants at 3 MeV. This value is a power of ten smaller than that found using the same model for pure gold. (GE)

23358 (RD/B/N-3169) TEMPERATURE DEPENDENCE OF VOID SWELLING IN ELECTRON IRRADIATED STAINLESS STEEL TYPE 304. Buswell, J. T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

Solution treated AISI 304 stainless steel was irradiated with 1 MeV electrons, in a high voltage electron microscope, at temperatures in the range 490 to 610°C. Clear evidence was obtained of a double peak in the temperature dependence of swelling at 20 dpa. The maximum swelling values occurred at 520 and 585°C, respectively. Swelling in the lower temperature peak was controlled by the void number density but swelling in the higher temperature peak was dependent upon the mean void size. The possibility exists that the presence and magnitude of the higher temperature peak was influenced by the stress conditions within the electron irradiated areas. (auth)

23359 (RD/B/N-3171) EXAMINATION OF THE DISTRIBUTION OF VOIDS IN ELECTRON IRRADIATED FOILS. Buswell, J. T. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

A series of experiments was previously carried out to determine the void swelling characteristics of solution treated AISI 304 stainless steel by irradiation with 1 MeV electrons in a high voltage electron microscope, at temperatures in the range 490 to 610°C. Examination of the spatial distributions of the voids produced in those experiments showed that the voids were not uniformly distributed throughout the thickness of the damaged regions. The form of the distributions of voids, and their contribution to the swelling, varied throughout the temperature range. It is suggested that the non-uniform distributions were the result of temperature gradients through the thickness of the specimens, causing the lower (electron exit) surface of the voided regions to be 10 to 20°C hotter than the upper (electron entry) surface. A temperature gradient through the thickness of a HVEM specimen can result from the use of the objective aperture during irradiation. (auth)

23360 (TID/SNA-519) CRYOGENIC RADIATION EFFECTS, Ti-5A1-2.5Sn ELI FORGING, t119-X2CD1-W181f3. Final Report GTR-20C Tests, 37NRO 028A and 029A. French, W. E.; Brown, D. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 65p. Dep. NTIS $6.25.

Ti 5Al 2.5Sn ELI forging in two forms (tensile and fracture toughness) was irradiated to three fluences (approximately 3×10^{17} n/cm^2, 1×10^{18} n/cm^2 and 6×10^{18} n/cm^2 > 1 MeV) and subsequently tensile and fracture toughness tested. During irradiation and testing, the specimens were submerged in liquid nitrogen to maintain the cryogenic temperature. Selected specimens (4 tensile and 4 fracture toughness irradiated to a fluence of 6×10^{18} n/cm^2 > 1 MeV) were annealed for 100 minutes at 540°R prior to tensile and fracture toughness testing in liquid nitrogen. During the annealing period resonant frequency measurements were conducted on the four high fluence tensile specimens. The Ti 5Al 2.5Sn ELI forging tensile property most sensitive to radiation was elongation, which exhibited significant decreases at fluences of 1×10^{18} n/cm^2 > 1 MeV and above. No significant ductility loss was experienced at a fluence of 3×10^{17} n/cm^2 (>1 MeV). A minor increase in elongation was measured due to annealing at 540°R for 100 minutes after irradiation to a fluence of 6×10^{18} n/cm^2 > 1 MeV. A significant decrease in fracture toughness occurred in specimens irradiated to a fluence of 1×10^{18} n/cm^2 (>1 MeV). No significant change in fracture toughness property in specimens irradiated to a 2.8×10^{17} n/cm^2 (>1 MeV) was observed. In three of four Ti 5Al 2.5Sn ELI forging tensile specimens irradiated to a fluence of 6×10^{18} n/cm^2 (>1 MeV) a significant reduction in resonant frequency, Hz, was observed. (auth)

23361 (WANL-TME-1822(Rev.2)) FINAL TEST SPECIFICATION: INCONEL-718 MATERIALS TEST, 37/W410; STEM SPECIMENS, 15/W202; STRESS RELAXATION SPECIMENS, 15/W101. Revision 2. Coombe, J. R.; Shogan, R. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1968. 38p. Dep. NTIS $5.00.

This specification is part of the NERVA radiation effects testing program. Tensile properties and stress relaxation are to be measured as functions of temperature, thermal and fast neutron fluence, grain size, heat treatment, and notches. Requirements and procedures for carrying out the test program are given. Specimen designs are included. (DLC)

23362 (WANL-TME-1960(Rev.1)) TEST SPECIFICATION: BERYLLIUM THERMAL CONDUCTIVITY IRRADIATION TEST 37/W414. Coombe, J. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 9p. Dep. NTIS $4.00.

Requirements and procedures are given for irradiating Be with fast neutron fluences, measuring its thermal and electrical conductivities, and pulse-annealing. (DLC)

23363 THE EFFECT OF NEUTRON FLUX ON DISLOCATION CLIMB. MacEwen, S. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). J. Nucl. Mater.; 54: No. 1, 85-96(Nov 1974).

The effect of temperature, flux, stress and sub-grain size on the enhancement of dislocation climb during irradiation was evaluated using solutions to Poisson's equation for a single dislocation located at an arbitrary position within a sub-grain. As the distance from the dislocation to the boundary is decreased the climb velocity decreases, but its temperature dependence remains unaltered. The temperature and flux dependence of in-reactor creep are found to be in agreement with the corresponding dependencies of enhanced climb, giving support to a climb plus glide model for in-reactor creep. It is shown that the flux exponent $p \equiv d \ln V/d \ln \phi$ can have values ranging from 0.5 to 1.0 depending on flux and sub-grain size, and that the Arrhenius plot of climb velocity can show three distinct regions. At high temperature the activation energy is that for self diffusion, while at low temperatures it equals one half the vacancy migration energy; intermediate is a region in which the climb velocity shows little or no temperature dependence. (auth)

23364 FAST-NEUTRON SPUTTERING OF IRON AT VARIOUS TEMPERATURES. Baer, T. S.; Anno, J. N. (Cincinnati Univ., Ohio (USA)). J. Nucl. Mater.; 54: No. 1, 79-84(Nov 1974).

The sputtering ratio for fast neutrons (average energy approximately 2 MeV) bombarding iron targets was determined at various temperatures. Over the temperature range of 200 to 340°C, the ratio varied from 3×10^{-3} to 8×10^{-3} with no uniform variation with temperature. These values are one to two orders of magnitude higher than predicted by random sputtering models, and yet an order of magnitude higher than predicted by an ordered model. (auth)

23365 AN EXPERIMENTAL SURVEY OF SWELLING IN COMMERCIAL Fe-Cr-Ni ALLOYS BOMBARDED WITH 5 MeV Ni IONS. Johnston, W. G.; Rosolowski, J. H.; Turkalo, A. M. (General Electric Co., Schenectady, N. Y. (USA). Research and Development Center); Lauritzen, T. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Development Operation). J. Nucl. Mater.; 54: No. 1, 24-40(Nov 1974).

The void swelling tendencies of over twenty Fe-Cr-Ni alloys were compared by bombarding with 5 MeV Ni ions. The bombardments were at 625°C, the peak swelling temperature established for Types 304 and 316. The largest swellings in commercial alloys occurred at compositions in the vicinity of 17 Cr-12 Ni, a region that includes Types 304, 316, 318, 321 and Sandvik 12R72HV. A number of commercial alloys, spanning a wide compositional range, showed greatly reduced swellings. The low swelling materials included precipitation hardened alloys, and solid solutions alloys. The results imply that the major composition of an alloy has a strong influence on swelling behavior. Special alloys of Fe, Cr and Ni were prepared with 15 wt % Cr and 15, 20, 30 and 35 wt % Ni. The swelling decreased markedly with increasing nickel content, dropping by a factor of >100 in going from 15% Ni to 35% Ni. There is an indication that the swelling in commercial alloys is also affected by the chromium content. The occurrence of low swelling over a wide compositional range in the Fe-Cr-Ni system provides confidence that a suitable low-swelling alloy can be selected for use in commercial LMFBR's. (auth)

23366 INTERSTITIAL LOOPS IN NEUTRON-IRRADIATED ALUMINIUM. Pochettino, A. A.; Ipohorski, M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Departamento de Metalurgia). J. Nucl. Mater.; 54: No. 1, 163-165(Nov 1974).

The nature of the large loops (diameter > 1000 Å) which appear in neutron-irradiated aluminium (99.999%) was determined by the well-known method of variation of sign of the quantity (g.b) s. Here b is the loop Burgers vector, g is the reciprocal lattice vector associated with the diffracting planes producing the image contrast, and s is the deviation parameter from the exact Bragg orientation. (auth)

23367 RESIDUAL STRESS MEASUREMENTS IN IRRADIATED SOLUTION-ANNEALED TYPE 304 STAINLESS STEEL TUBING. Foster, J. P.; Wolfer, W. G. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.); Strain, R. V. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 117-127(Nov 1974).

Immersion density and residual stress measurements were made on solution-annealed Type 304 stainless steel capsule tubing irradiated up to fluence levels of 9×10^{22} n/cm^2 (E > 0.1 MeV). The measured residual stress is dependent on the competition between differential swelling which builds up differential stresses, and irradiation creep which relaxes these stresses. The measurements were analyzed using a bilinear swelling equation formulated with swelling data from the same heat of material. The temperatures and fluence levels of the swelling and slit tube data were each calculated with the same computer code. At high fluence, when swelling was in the steady-state region, the effective irradiation creep rate increased by a factor of about three. Further analysis was made assuming that stress-enhanced swelling and swelling-enhanced irradiation creep were the enhanced relaxation mechanisms. (auth)

23368 SOME ELECTRON BEAM EFFECTS ON CO/W(100), C_2H_4/W(100) AND TUNGSTEN CARBIDE. Chesters, M. A.; Hopkins, B. J.; Jones, A. R.; Nathan, R. (Univ. of Southampton, Eng.). J. Phys., C (London); 7: No. 24, 4486-4492(21 Dec 1974).

Electron beam effects have been investigated on CO/W(100) and tungsten carbide at 300°K and C_2H_4/W(100) at 80°K. All three are considerably influenced by the action of beam currents lower than those commonly used in Auger electron spectroscopy. Oxygen in the CO/W(100) system is almost totally removed after about

200 μA min beam exposure with an initial total desorption cross section of $4 \pm 2 \times 10^{-20}$ cm^2. A noticeable change in the carbon peak shape was observed at 80°K after ~1 μA min beam exposure. (auth)

23369 NEUTRON SMALL-ANGLE SCATTERING INVESTIGATION OF VOIDS IN NEUTRON-IRRADIATED ALUMINIUM SINGLE CRYSTALS. Hendricks, R. W.; Schelten, J.; Schmatz, W. (Kernforschungsanlage, Juelich, Ger.). J. Appl. Crystallogr.; 7: No. 2, 223(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

Large single crystals of high-purity aluminum (99.9999 + %), in the form of cylinders 25 mm dia × 40 mm long, were irradiated in the removable beryllium shield of the Oak Ridge High-Flux Isotope Reactor to fluences between 5×10^{20} and 1.5×10^{21} n/cm^2 (E > 0.1 MeV). Six of these crystals have been examined at the neutron small-angle scattering facility at the FRJ-2 reactor in Jülich. Scattering curves have been measured in essentially a point geometry at specimen-to-detector distances of 12, 5, 2, and 1 m, which cover a K range of 2×10^{-3} to 2×10^{-1} Å in overlapping steps. The scattering from the irradiated specimens is well above the scattering from the unirradiated single crystals except at the largest K vectors, where the intensity is principally the weak incoherent scattering from Al. Nonsymmetric scattering effects were observed in the high-angle tails of the curves from the unirradiated specimens. Throughout, especial attention has been paid to the scattering curves in the regions of relatively high K where a previously small-angle X-ray investigation has suggested that there may be some effects from voids or other scattering centers which are below the limit of resolution of the electron microscope. These data are compared with electron microscopy, small-angle X-ray scattering, and immersion density measurements. The void-size distribution function and its first three moments are computed. (auth)

23370 STEADY-STATE POINT-DEFECT DIFFUSION PROFILES IN SOLIDS DURING IRRADIATION. Lam, N. O.; Rothman, S. J.; Sizman, R. (Argonne National Lab., IL). Radiat. Eff.; 23: No. 1, 53-59(Sep 1974).

The steady-state distribution of mobile point defects in a monatomic solid under irradiation was calculated for a semi-infinite solid and for a foil. The calculation was performed for defect annihilation by mutual recombination, at internal sinks, and by diffusion to the surface. Simple approximations, accurate to within 5%, were developed for the analytical solutions to the differential rate equations. (auth)

23371 TRAPPING AND RELEASE OF RARE GASES BY 304L STAINLESS STEEL. Rantanen, R. O.; Donaldson, E. E. (Washington State Univ., Pullman). Radiat. Eff.; 23: No. 1, 37-42(Sep 1974).

Helium and argon ions at 100 to 1400 eV and doses from 10^{12} to 10^{15} ions/cm^2 were implanted in a 304L stainless steel sample. Following implantation, a linear temperature increase of the sample caused the gases to be released. The thermal release rates were studied as a function of ion dose and energy. Maxima observed in the thermal release rates are used to determine activation energies for thermally activated processes occurring in the metal. A rapid increase in the CO release rate coincident with the highest temperature He re-emission maximum indicates that the same mechanism is responsible for the release of both CO and He. It is suggested that the transport mechanisms revealed here are important in controlling void formations in neutron-irradiated metals. (auth)

23372 STRUCTURE STUDIES OF THE NEAR-SURFACE LAYER OF Ge CRYSTALS AT THEIR BOMBARDMENT WITH ACCELERATED IONS AT VARIOUS TEMPERATURES. Lebedev, S. Ya.; Omelyanovskaya, N. M. (Inst. of Physics and Power Engineering, Obninsk, USSR). Radiat. Eff.; 23: No. 1, 1-5(Sep 1974).

The ion-electron emission (IEE) coefficient γ of the (111) face of a Ge single crystal after irradiation with Ar^+, Kr^+ and N_2^+ was studied over a broad energy range. It was determined that at temperatures near to T_a the annealing of radiation damage which affects the transparency of channels and at lower temperatures leads to surface layer amorphization takes place. T_a values for all investigated ions were determined. Sharp changes of γ in a narrow temperature range of $T_a \pm \Delta T$ are observed to be followed by continuous falling of γ for all angles of bombardment. This falling is related to the subsequent annealing of remaining structure damage influencing conditions of electron escape from the crystal. At temperatures of the order of 600°C, the γ (T) curves for all bombardment angles and all ions studied reach the plateau apparently caused by full or very fast annealing of all radiation damage at this temperature. (auth)

23373 IRRADIATION CREEP AND SWELLING. Heald, P. T.; Speight, M. V. (Central Electricity Generating Board, Berkeley, CA). Phil. Mag.; 30: No. 4, 869-875(Oct 1974).

A rate theory of irradiation creep and volume swelling is presented. The volume swelling occurs at temperatures sufficiently high for void nuclei to be formed by the inert gas fission products; since dislocations absorb interstitials more readily than they do vacancies the voids are able to grow by a vacancy-diffusion mechanism. The volume swelling rate falls rapidly to zero when the thermal equilibrium concentration of vacancies becomes comparable with the irradiation-produced concentration. The irradiation creep arises from the stress-induced inhomogeneity interaction between point defects and dislocations, which results in a stress-assisted climb of the dislocations. The creep rate is insensitive to temperature changes at low temperatures where swelling does not occur. In the swelling regime the creep rate increases with temperature. (auth)

23374 THEORY OF DISLOCATION CREEP FOR A MATERIAL SUBJECTED TO BOMBARDMENT BY ENERGETIC PARTICLES. Role of Thermal Diffusion. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Phil. Mag.; 30: No. 4, 751-764(Nov 1974).

The equation for the irradiation creep of a material subjected to bombardment by energetic particles which was developed from continuum mechanics arguments in an earlier paper is derived independently from a dislocation model. This reduces the unknowns in the creep equation from two to one. The model, which examines the balance between hardening and recovery, is one which has recently been found to give a reasonable fit to thermal creep data. Its use enables predictions to be made for the irradiation creep rate at around half the absolute temperature of melting. Quite good agreement is found with irradiation-creep data, particularly for a zirconium alloy (Zircaloy 2). The equation is used to define the boundaries between irradiation creep, dislocation creep and diffusion creep on a relaxation-time map for stainless steel. (auth)

23375 STUDIES OF VOIDS IN NEUTRON-IRRADIATED ALUMINIUM SINGLE CRYSTALS. I. Small-Angle X-ray Scattering and Transmission Electron Microscopy. Epperson, J. E.; Hendricks, R. W.; Farrell, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phil. Mag.; 30: No. 4, 803-817(Oct 1974).

Small-angle x-ray scattering and transmission electron microscopy experiments were performed on high-purity (99.9999 + %) aluminium single crystals that were neutron-irradiated to a fluence of 1.5×10^{21} n/cm^2 (>0.18 MeV) at 50°C. The volume changes determined by each technique are in reasonably good agreement. Evidence for scattering effects resulting from faceting of the voids is presented. Assuming a truncated octahedral void shape, the ratios of the third to the second moment of the distribution of void sizes determined by both SAXS and TEM are in excellent agreement. The effects of isochronal annealing on the swelling have been followed to near the melting point. The annealing-out of voids was clearly seen; no evidence was found for bubble formation at elevated temperatures. (auth)

23376 STUDIES OF VOIDS IN NEUTRON-IRRADIATED ALUMINIUM SINGLE CRYSTALS. II. Small-Angle Neutron Scattering. Hendricks, R. W.; Schelten, J.; Schmatz, W. (Oak Ridge National Lab., TN). Phil. Mag.; 30: No. 4, 819-837(Oct 1974).

Absolute small-angle neutron scattering measurements were made on six aluminium single crystals irradiated with fast neutrons (>0.18 MeV) to fluences between 0.3 and 2.0×10^{21} n/cm^2. Results are interpreted in terms of the truncated octahedral shape of voids, and are compared with companion transmission electron microscopy and immersion density measurements. Swelling, total void surface area, radius of gyration, and the moment ratios of the size distribution ($\langle D^6 \rangle / \langle D^3 \rangle$ and $\langle D^3 \rangle / \langle D^2 \rangle$) are in good agreement. These quantities are not only fluence-dependent but also show a marked temperature dependence resulting from the small thermal gradient in the reactor core. (auth)

23377 HYDRAULIC APPARATUS FOR IN-CHANNEL TESTING OF STRUCTURAL MATERIALS. Kozhevnikov, O. A.; Ul'pe, L. R. Sov. At. Energy (Engl. Transl.); 36: No. 6, 648-650(Jun 1974.

Translated from At. Energ. (USSR); No. 6, 513-515(Jun 1974).

The model DPRG hydraulic in-channel test apparatus was designed for studying the effect of neutron irradiation on the endurance of structural materials used in the vertical reflector channel of the model SM-2 Reactor. The design is described and the entire assembly is inserted into or withdrawn from the vertical channel of the reactor through a window in the swinging roof. Data obtained on the endurance of the Ti–2% Al–3% Zr alloy unexposed and during neutron irradiation in the channel of the SM-2 are tabulated for 20 and 180°C for unirradiated and for 80 and 150°C for

neutron-irradiated testing temperatures. The flux density of neutrons at above 1 MeV energy levels was 1.1 to 1.7 × 10^{14} neutrons/cm^2 sec. (MCW)

23378 STRUCTURAL TRANSFORMATIONS DURING THE BOMBARDMENT OF IRON, NICKEL, AND MOLYBDENUM WITH Ar^+, N^+, AND C^+ IONS. Pavlov, P. V.; Tetel'baum, D. I.; Pavlov, A. V.; Zorin, E. I. (Gorky Scientific-Research Physical-Technical Inst., USSR). Dokl. Akad. Nauk SSSR; 217: No. 2, 330-332(1974). (In Russian).

Films of Fe, Mo, and Ni were bombarded with Ar^+, N^+, and C^+ ions at 40 keV. Before bombardment, the Fe and Mo had bcc lattices and the Ni was fcc. The Fe and Ni were transformed into hcp structures and the Mo into fcc. The electronographic data from the irradiated metal films are tabulated and compared with previous experimental values or calculated values. (JSR)

23379 OBSERVATIONS OF SPUTTERING DAMAGE USING THE FIELD-ION MICROSCOPE. Walls, J. M.; Southworth, H. N. (Univ. of Birmingham, Eng.). Vacuum; 24: No. 10, 471-474(Oct 1974).

The field-ion microscope was used to study the effects of bombarding tungsten surfaces with low-energy noble gas ions. By bombarding with neon, argon, and xenon ions at 100 eV to 1 keV, information was obtained on the type and distribution of the lattice damage produced, together with the effects of annealing. These results are relevant to those surface techniques such as LEED, Auger electron spectroscopy, and x-ray photoelectron spectroscopy which employ low-energy ion bombardment as a means of removing surface contamination. (DLC)

23380 MOESSBAUER EFFECT INVESTIGATION OF THE VIBRATIONAL BEHAVIOUR OF INTERSTITIALS TRAPPED AT ^{57}Co IMPURITIES IN ALUMINIUM. Vogl, G.; Mansel, W.; Vogl, W. (Technische Univ., Munich). J. Phys., F (London); 4: No. 12, 2321-2330(Dec 1974).

The temperature dependence of the Debye–Waller factor of highly dilute ^{57}Co in aluminium was measured before and after fast-neutron irradiation at 4.6°K. After irradiation at 4.6°K followed by annealing between 35 and 160°K, there appeared an additional Moessbauer line due to irradiation-induced aluminium interstitials trapped at the ^{57}Co impurities. The temperature dependence of the Debye–Waller factor of the additional line is much stronger than that of the original line, indicating the appearance of low frequency vibration modes of the impurity-interstitial complex. Good agreement with the experimental data is obtained by fitting them with a low frequency Einstein vibration mode $\omega_{low} \simeq 6.5 \times 10^{12}\ s^{-1} \simeq 0.1 \times \omega_{max,\,Al}$ and a high frequency mode $\omega_{high} \simeq 6 \times 10^{13}\ s^{-1} \simeq \omega_{max,\,Al}$. Supplementary investigations of the second-order Doppler shift, in general, confirm this picture. (auth)

23381 STRESS–INDUCED DIFFUSION OF POINT DEFECTS TO SPHERICAL SINKS. Wolfer, W.G. (Westinghouse Advanced Reactor Division, Madison, Pennsylvania 15663); Ashkin, M. J. Appl. Phys. 46: No. 2, 547-557 (Feb 1975).

Radiation damage in metals at elevated temperatures produces small dislocation loops and voids. The growth of these sinks is determined by the steady–state diffusion of point defects migrating in the stress field of these sinks. To obtain the steady–state current of point defects to these spherical sinks a perturbation method is developed to deal with the drift term of the diffusion equation. It is shown that the contribution of the drift term to the current can be expressed by a bias factor which differs from unity if the point defects interact with the spherical sink. Explicit expressions of the bias factors for voids and infinitesimal dislocation loops are given. If the metal is subject to external loads the bias factors of voids depend on the elastic dilatation, whereas the bias factors for dislocation loops depend on the deviatoric elastic strain. These results then provide the basis for stress–induced swelling and irradiation creep of metals. Both of these phenomena are briefly discussed. (auth)

23382 SUPERCONDUCTING WEAK LINKS FORMED BY ION IMPLANTATION. Arrington III, C.H.; Deaver, B.S. Jr. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). Appl. Phys. Lett. 26: No. 4, 204-206 (15 Feb 1975).

The superconducting order parameter has been controllably reduced in a narrow band across a strip of Nb thin film by implanting iron ions into the film. The resulting weak link exhibits the Josephson effects and is exceptionally rugged, both physically and electrically. (auth)

23383 ANOMALOUSLY LOW FRICTION OF AN ELECTRON BOMBARDED SURFACE OF MOLYBDENUM DISULFIDE. Dukovskoi, E.A.; Ponomarev, A.N.; Silin, A.A.; Tal'roze, V.L. (Institute of Chemical Physics, USSR Academy of Sciences). JETP Lett. 20: No. 4, 119-120 (20 Aug 1974).

We present experimental data on the production of anomalously low friction by electron bombardment of a molybdenum–disulfide surface. It is indicated that the effect and its mechanism are identical when the molybdenum disulfide is bombarded by electrons and by accelerated helium atoms. (auth)

23384 FLUX DEPENDENCE OF VOID NUCLEATION AND VOID GROWTH IN 2.8–MeV NICKEL–ION–IRRADIATED NICKEL. Westmoreland, J.E.; Malmberg, P.R. (Van de Graaff Branch, Radiation Technology Division, Naval Research Laboratory, Washington, D.C. 20375); Sprague, J.A.; Smidt, F.A. J. Vac. Sci. Technol. 12: No. 1, 511-515 (Jan 1975).

Swelling in reactor materials can be simulated, at least qualitatively, by irradiation with heavy ions in a small fraction of the time required with neutron irradiation. However, the 10^3–10^5 higher production rate of initial damage which makes simulation feasible may also obscure subtle microstructural changes. Thus, the dose rate effects need to be understood. The present investigation obtained a quantitative comparison between the damage parameters in 2.8–MeV nickel–ion–irradiated nickel, where the nickel ion flux was the only variable, being changed by a factor of 100. Preliminary results of studies of some of the samples of this investigation were described at a recent conference.[1] The paper presents further analyses of these and other samples and comparison with theories of void nucleation and void growth. (auth)

23385 SWELLING STUDIES OF VANADIUM AND A VANADIUM–1 WT % TITANIUM ALLOY USING ION SIMULATION TECHNIQUES. Santhanam, A.T.; Taylor, A.; Kestel, B.J.; Steves, C. (Argonne National Laboratory, Argonne, Illinois 60439). J. Vac. Sci. Technol. 12: No. 1, 528-531 (Jan 1975).

The void swelling of HPV and V–1 Ti has been investigated by irradiating the samples side by side with 3–MeV $^{51}V^+$ ions to damage doses between 2.4 and 54 dpa at a temperature of 700°C. Examination of the irradiated samples by transmission electron microscopy revealed that voids and dislocation networks had formed at 2.4 dpa in HPV and that swelling increased less than linearly with dose. In contrast, V–1 Ti showed negligible swelling even at 54 dpa. The swelling resistance of V–1 Ti to large doses is believed to be, at least in part, due to irradiation–induced precipitation. (auth)

23386 RADIATION DAMAGE IN COPPER SINGLE CRYSTALS. Sood, D.K.; Dearnaley, G. (A.E.R.E., Harwell, England). J. Vac. Sci. Technol. 12: No. 1, 463-467 (Jan 1975).

Mo, Au, and Cu ions of 150–350–keV energy have been implanted, off axis, in <110> Cu single crystals at a dose of 10^{16} ions/cm^2. The radiation damage and its annealing are studied by backscattering and channeling of a 3.5 MeV alpha–particle beam. There is no significant surface disorder. The radiation damage, however, has been found to extend to rather large depths, up to 16 times the projected range of the implanted ions. Annealing of the disorder caused by 150–keV Mo ions has been studied up to 900°C. The disorder anneals gradually at rather high temperatures accompanied by a marked decrease in the disorder depth. This suggests depletion of the disorder from within the crystal towards the surface. The disorder has also been studied as a function of substrate temperature, during implantation, from −130° to 350°C. The results are interpreted in terms of the existing radiation damage theory and arguments based upon consideration of surface stress. (auth)

23387 PROTON–INDUCED ELECTRON EMISSION FROM CHARACTERIZED NIOBIUM SURFACES. Musket, R.G. (Sandia Laboratories, Livermore, California 94550). J. Vac. Sci. Technol. 12: No. 1, 444-447 (Jan 1975).

Both the electron emission coefficient (electrons/ion) and the energy distribution of emitted electrons have been determined for bombardment of polycrystalline niobium by 30–400 keV protons. *In situ* characterization of the niobium surfaces was accomplished using electron–induced Auger electron spectroscopy. Emission coefficient measurements were made for protons incident along the surface normal and along the axis at 45° from the surface normal. Electron energy distributions were determined using a hemispherical retarding analyzer with the proton beam at 45° from the surface normal and at 90° from and coplanar with the axis of the analyzer. The results are discussed and interpreted with reference to electron emission theories and previous experiments. (auth)

23388 CARBIDE FORMATION ON Nb SURFACES DURING HIGH–TEMPERATURE H IRRADIATION. Thomas, G.J.; Bauer, W. (Sandia Laboratories, Livermore, California 94550). J. Vac. Sci. Technol. 12: No. 1, 490-495 (Jan 1975).

We have observed the formation of "star–shaped" features ~1–10 μ in size on the surfaces of Nb samples after implantation with 150 keV H at 975–1275 K. Depending on specific conditions of temperature, vacuum, and surface preparation, they are sometimes found only within the implanted region, and sometimes over the entire sample surface. Scanning and transmission electron microscopy, and scanning Auger analysis, indicate that the features are due to the formation of Nb_2C precipitates. These results suggest that carbide growth can occur on Nb surfaces at high temperatures under CTR–like vacuum conditions, and that the formation of carbides can be enhanced in a

radiation environment. This process can have important consequences on the use of Nb for CTR first wall applications. (auth)

23389 SURFACE STRESSES IN ION–IMPLANTED STEEL. Hartley, N.E.W. (Building 8, AERE Harwell, Didcot, Oxon., OX11 ORA, U. K.). J. Vac. Sci. Technol. 12: No. 1, 485-489 (Jan 1975).

Recent work on ion–implanted metals has demonstrated the existence of substantial changes in friction and wear properties brought about by ion implantation. The effects have been attributed to corrosion inhibition, metallurgical transformation, or mechanical surface hardening. In the work to be presented, a capacitance probe apparatus is described which has been used to detect the deflection occurring during ion implantation of thin specimens of annealed steel. The deflection is related to the introduction of a surface compressive stress. 100–keV argon ion implantation is found to produce surface stresses of several thousand lbs/in.^{2} which reach a maximum at a dose approximately 5.0×10^{16} ions–cm^{-2}. Light ions, such as nitrogen, which form chemically stable compounds within the steel, generate similar stresses within the surface such that a macroscopic deflection of the specimen can be observed. In this case very high doses are required to maximize the stress ($\sim10^{17}$ ions–cm^{-2}). The results are interpreted with reference to damage mechanisms and nitride formation, and are discussed in relation to the mechanical property changes previously reported. (auth)

23390 STACKING FAULTS IN NICKEL FILMS IRRADIATED WITH HELIUM IONS. Bykov, V. N.; Zdorovtseva, G. G.; Troyan, V. A.; Khaimovich, V. S. (Obninsk Branch, Engineering-Physics Institute). Sov. Phys.-Cryst. (Engl. Transl.); 19: No. 4, 558-559 (Jan 1975).

The change in stacking fault concentration in helium ion irradiated nickel films is determined as a function of radiation dosage and annealing temperature. (AIP)

23391 EFFECT OF IRRADIATED SAMPLE CHARGE ON THE RADIATION CREEP OF METAL CRYSTALS. Troitskii, O. A.; Spitsyn, V. I.; Gusev, E. V. (Moscow Inst. of Physical Chemistry). Dokl. Akad. Nauk SSSR; 217: No. 5, 1133-1135(1 Aug 1974). (In Russian).

The effect of the removal of the charge from deformed metal crystals, irradiated with electrons at energies below the knock-on threshold, on the rate of radiation creep was studied for Pb, Zn, In, and Sn. The results showed that the steady-state creep rate of the irradiated samples is increased by charge removal. (JSR)

23392 LOW ENERGY ION TRAPPING AND GAS RELEASE FROM NICKEL SINGLE CRYSTALS. Reed, D. J.; Armour, D. G.; Carter, G. (Univ. of Salford, Eng.). Vacuum; 24: No. 10, 455-461(Oct 1974).

A study was made of the thermal release of helium implanted into randomly oriented nickel single crystals at 1 keV. The effects of dose, dose rate and implant temperature on post-bombardment gas evolution rate spectra have been investigated. On the basis of the spectra obtained a model for low energy helium trapping is suggested which is consistent with previously observed dose dependent trapping probability and explains the almost total inhibition of gas trapping observed at implant temperatures in excess of 450°C. The model is also used to explain the observed evolution rate maxima associated with release from small gas bubbles formed during annealing. The ultimate formation of the suggested gas bubbles has been shown to be strongly dependent on incident dose and co-incident with enhanced gas trapping. (auth)

Other Materials

Refer also to abstracts 22557, 23212–23218, 23250, 23312, 23341, 23342, 23355, and 25007.

23393 (AD-783374) ZERO-FIELD PARAMAGNETIC RESONANCE OF TRIVALENT GADOLINIUM IN SEVERAL LANTHANON (SIC) TRIS (ETHYLSULFATE) NONAHYDRATES AND NONADEUTERATES: DETERMINATION OF CRYSTAL FIELD AND HYPERFINE STRUCTURE PARAMETERS. Technical Report. Bernstein, E. R.; Dobbs, G. M. (Princeton Univ., N. J. (USA). Dept. of Chemistry). 1974. 81p. (AROD-12155.1-C). NTIS $4.00.

Employing isotopically pure trivalent ^{155}Gd, ^{157}Gd, and ^{160}Gd as guests in dilute mixed crystals of lanthanum tris(ethylsulfate) nonahydrate ($La_3(C_2H_5SO_4)3\text{-}9H_2O$), it has been possible to determine both accurate zero-field splitting parameters of crystal field origin and hyperfine structure constants due to magnetic dipole and electric quadrupole interaction terms. It is reasoned that the quadrupole hyperfine constant is due, almost entirely, to lattice contributions. The hyperfine anomaly is discussed. A set of crystal field parameters are reported for the first time for ^{160}Gd in crystals of $La(C_2H_5SO_4)3\text{-}9D_2O$ which differ significantly from those of the hydrate. Variations of crystal field parameters with various lanthanon host ions are also observed. Finally, a few comments concerning zero-field line widths and their measurement are made. (GRA)

23394 (AD-785082) ANALYSIS OF PHYSICAL PARAMETERS IN ELECTRON-BEAM-IRRADIATED SEMICONDUCTOR DIODES. Interim Report. Haas, G. A. (Naval Research Lab., Washington, D. C. (USA)). 31 Mar 1972. 32p. (NRL-7366). NTIS $3.25.

The basic interaction theory of parameters such as thickness, impurity density, area, and external supply voltage required for various power-frequency applications is discussed for multiple electron-beam-irradiated semiconductor diodes connected in series. Two general approaches are outlined for use in CW Class-B applications: (1) A minimum-thickness approach for reducing the transit-time limitations for a tuned-output high-frequency type of operation, and (2) a minimum-area approach for reducing the diode capacitance, as is desired for wide-bandwidth applications. Guidelines are also provided for changing the design conditions by altering constraints such as maximum allowed electric field, minimum allowed electric field, and heat dissipation. The power-frequency capabilities of the device are discussed in terms of present state-of-the-art fabrication limitations in controlling thickness, electromigration of the Al overlayer, uniformity of the electron beam, and electron-hole generation rate. (GRA)

23395 (AD-786664) CRITICAL REVIEW OF THE WORK ON DETERMINATION OF NUCLEAR RADIATION EFFECTS IN SOLIDS BY ULTRASONIC ATTENUATION. Research and Development Technical Report, 1960–1964. Greenberg, I. N. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Aug 1974. 33p. (ECOM-4245). NTIS $3.75.

The literature in which the effects of irradiating various solids with fast neutrons or gamma rays have been determined by the change in ultrasonic attenuation from preirradiation values has been critically reviewed. It has been shown that the mechanism whereby the change in attenuation occurs yields information on the nature of the radiation-caused defects. Examples used are Na, Cl, and quartz. (GRA)

23396 (AD-786665) GAMMA RAY INDUCED CHARGE BUILDUP IN INSULATORS. Research and Development Technical Report. Kronenberg, S.; Lux, R. A.; Nilson, Kristian L.; Jurczyk, G. K.; Pfeffer, R. L. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Sep 1974. 20p. (ECOM-4252). NTIS $3.25.

Irradiation of an insulator by gamma rays can produce voltage and charge buildups near thin layers of foreign material within the insulator. Measurements were made of the current produced as a function of atomic number and thickness of the perturbing layer. Current was also measured as a function of separation from the perturbation, as was voltage buildup within the insulator close to the perturbation. (auth)

23397 (AED-CONF-74-328-001) TSC MEASUREMENTS ON BORON IMPLANTED SILICON JUNCTIONS. Muller, J. C.; Stuck, R.; Siffert, P. (Centre National de la Recherche Scientifique, 67–Strasbourg (France). Lab. de Physique des Rayonnements et d'Electronique Nucleaire). 1974. 12p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

Thermally stimulated current (TSC) measurements were performed directly on junctions formed by implantation of low energy (<100 keV) boron ions into N-type silicon after annealing treatments at different temperatures between 100 and 500°C. The TSC curves were analyzed by a new method based on the measurement of the mean time before re-emission of the trapped carriers. The influence of several parameters, like bombarding energy, implant temperature, and resistivity of the starting silicon, were considered. If the implantations are performed at room temperature, for a bombarding energy of 15 keV only one level at $E_v + 0.26$ eV attributed to the divacancy is found. For an energy of 60 keV additional levels at $E_c - 0.18$, $E_v + 0.31$ and $E_c - 0.44$ eV appear. If the implantation occurs at liquid nitrogen temperature even for 60 keV only the level at $E_v + 0.26$ eV is present. (auth)

23398 (AED-CONF-74-328-005) REDISTRIBUTION OF BORON IN SILICON THROUGH HIGH TEMPERATURE PROTON IRRADIATION. Baruch, P.; Castaing, C.; Monnier, J.; Blanchard, B. (Ecole Normale Superieure, 75–Paris (France). Groupe de Physique des Solides). 1974. 10p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

The effect of high temperature proton irradiation on impurity distribution was shown to involve more complicated effects than

the enhancement of diffusion through an increase of defect density. In the case of boron in silicon, studied by secondary ion mass spectrometry, the distribution is largely perturbed at the end of the proton range, after irradiation at 850°C by 150 to 400 keV protons, with fluences from 1 to 6×10^{17} p/cm^2. Both in uniformly doped and in prediffused samples, accumulation and depletion of boron can be seen in a narrow region, involving atom movement against the initial concentration gradient, or creating such a gradient. Such an effect must be attributed to interaction of boron with the defects created by irradiation, giving species with different mobilities. There appears to be a mechanism in which interstitials, created directly or by the Watkins mechanism, flow out from the damage peak, while by competing mechanism, immobile clusters or precipitates drain part of the substitutional impurities. (GE)

23399 (AED-CONF-74-328-008) LATTICE DEFECTS AND PHOTOCONDUCTIVE DECAY TIME CONSTANT IN CdTe SINGLE CRYSTALS GROWN FROM SOLUTION. Taguchi, T.; Shirafuji, J.; Inuishi, Y. 1974. 21p. INIS.

From international conference on lattice defects in semiconductors; Freiburg in Breisgau, F. R. Germany (22 Jul 1974).

With abstract.

The effects of irradiation on photoluminescence spectra, photoconductive decay time constant, and electrical properties were investigated in CdTe single crystals grown from melt phase and from solutions of Te or $CdCl_2$. The 1.1 eV emission band appeared after electron irradiation at 77°K and anneals at 120°K, and is assigned to the simple Te vacancy. The electron trapping level at 0.06 eV below the conduction band is characteristic in Cl-doped samples and is associated with Cl atoms. The 160 MeV acceptor level which relates to the 1.42 eV emission band is possibly due to a complex involving Te vacancy. The common annealing stage at 330 to 350°K is observed in electrical properties, photoluminescence spectrum and photoconductive decay time constant in p-type sample. (auth)

23400 (AED-CONF-74-328-009) TIN-VACANCY INTERACTION IN SILICON MONITORED BY ^{119m}Sn MOESSBAUER PROBE. Matsui, Keiji; Hasiguti, Ryukiti; Shoji, Tadayoshi; Ohkawa, Atsushi. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). 1974. 10p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

With abstract.

Neutron irradiation and annealing of ^{119m}Sn doped silicon were studied to monitor vacancy by the Moessbauer probe adjacent to the defect. The spectra found after diffusion of ^{119m}Sn at 1,300°C show a singlet with isomer shift of + 1.85 ± 0.05 mm/s ($BaSnO_3$ standard) and effective Debye temperature of 281 ± 10°K, in agreement with substitutional tin. Irradiation with 1.4×10^{18} n/cm^2 at 80°C of n-type pulled crystal with 7×10^{17} P/cm^3 leaves the substitutional tin unaffected. Pulse annealings at 125 to 140°C produce a doublet with quadrupole splitting (1.08 ± 0.1 mm/s) and without isomer shift change. In p-type floating zoned crystal with 7×10^{13} B/cm^3 irradiated with 0.7×10^{18} n/cm^2, part of the substitutional tin atoms become converted to give rise to a singlet with isomer shift of +1.50 ± 0.05 mm/s. Both of the new spectra annihilate at about 180°C to return to the substitutional tin singlet. The n-type doublet is described by a bond composed of 5 sp orbitals. The p-type singlet is represented by a bond with enhanced p-character compared to the sp^3 bond. They are considered to be two Fermi-level-dependent spectra of tin-vacancy pair. (GE)

23401 (AED-CONF-74-328-014) DIFFERENCES IN DEFECT PRODUCTION AND ANNEALING PROCESSES IN BORON- AND CARBON-IRRADIATED GERMANIUM. MacDonald, P. J.; Palmer, D. W. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). 1974. 13p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

Samples of n-type germanium irradiated with non-channelled 60 keV $^{11}B^+$ and $^{12}C^+$ ions at room temperature to doses of 10^{15} ions/cm^2 at several dose-rates have been compared by measurements of electrical properties and of lattice disorder concentrations (using the proton channelling/back-scattering method) before and after successive isochronal thermal annealing treatments to 550°C. It was found that both the boron- and carbon-irradiated layers were p-type, but that there were differences in lattice disorder, in electric resistivity, and in annealing behavior. (GE)

23402 (AED-CONF-74-328-025) DEFECT TRANSFORMATIONS IN N-TYPE GERMANIUM IRRADIATED WITH ELECTRONS AT 140°K. Jaworowski, A.; Rzewuski, H. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). 1974. 17p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

The annealing processes in As- and Sb-doped germanium irradiated with electrons of different energy at 140°K revealed a new defect transformation stage centered at 230°K with carrier concentration recovery and Hall mobility reverse recovery, which did not depend on the impurity concentration and the type of doping. From the energy dependence of the defect transformation rate for the stage 230°K, a threshold energy of about 0.7 MeV was evaluated. From the results obtained, the conclusion has been drawn that defects are created with a relative concentration depending on the energy of the incident electrons. It is suggested that the main transformation process occurring at 230°K consists in the dissociation of $(V^{-2}V^{-2}I^{+})^{-3}$ into $I^{+} + V_2^{-4}$ influencing the subsequent transformation processes at 330°K. (auth)

23403 (AED-CONF-74-328-026) ON THE INTERACTION OF THE PRIMARY RADIATION DEFECTS WITH IMPURITIES IN p-TYPE SILICON AT 80-200 K. Vavilov, V. S.; Spitsyn, A. V.; Kolodin, L. G.; Mukashev, B. N.; Nussupov, K. H.; Takibaev, Z. S.; Tnishtikbaev, K. B. (AN SSSR, Moscow. Inst. Fiziki). 1974. 7p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974).

With abstract. Available from ZAED.

Influence of the acceptor type (Al, B) and concentration and the oxygen content in p-type Si on the defects buildup under 80°K 2 MeV-electron irradiation, and also on their annealing in the range 150 to 200°K was studied. It was observed that the defects, introduced by 80°K irradiation, act as much more effective scattering centers, when Si doped with Al, than in the case of Si with B impurity. To explain this fact it is suggested that the prevailing kind of the (silicon interstitial-acceptor) interaction depends on the acceptor atom size. It was found that the introduction rate of the acceptor-vacancy complex (the $E_v + 0.45$ eV level center) depends on the impurity atom size. (GE)

23404 (N-74-29982) SOME METAL–GRAPHITE AND METAL–CERAMIC COMPOSITES FOR USE AS HIGH ENERGY BRAKE LINING MATERIALS. Bill, R. C. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1974. 22p. (NASA-TN-D-7756). NTIS $3.00.

Materials were studied as candidates for development as potential new aircraft brake lining materials: (1) copper–graphite composites; (2) nickel–graphite composites; (3) copper–rare-earth oxide (Gd_2O_3 or La_2O_3) composites and copper–rare-earth oxide (La_2O_3)–rare-earth fluoride (LaF_3) composites; (4) nickel–rare-earth oxide composites and nickel–rare-earth oxide–rare-earth fluoride composites. For comparison purposes, a currently used metal–ceramic composite was also studied. Results showed that the nickel–Gd_2O_3 and nickel–La_2O_3–LaF_3 composites were comparable or superior in friction and wear performance to the currently used composite and therefore deserve to be considered for further development. (auth)

23405 (Y-DA-5841) FABRICATION OF GRAPHITES FROM SYNTHETIC ORGANIC COMPOUNDS. Napier, J. M.; Overholser, L. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1974. Contract W-7405-eng-26. 30p. (CONF-741051-1). Dep. NTIS $4.50.

From the Pacific coast regional meeting of the American Ceramic Society; Los Angeles, California, USA (23 Oct 1974).

Relatively high-strength graphites having good thermal stress resistance, high strain-to-failure, and low electrical resistivity may be fabricated by hot molding a blend of CAI or ACN carbon filler containing 1 wt % of green rayon fibers and 25 pph of ITX binder followed by impregnation with CAI pitch in the as-molded state prior to graphitization at 3000°C. (CAI = cinnamylideneindene, ACN = acenaphthylene, ITX = isotruxene) (10 fig, 4 tables) (auth)

23406 THERMALLY STIMULATED CURRENT AND THERMOLUMINESCENCE IN ZINC SULPHIDE. Bryant, F. J.; Kydd, R. F. (Univ. of Hull, Eng.). Solid State Commun.; 15: No. 11-12, 1929-1932(15 Dec 1974).

A comparative study was made of trapping centres in zinc sulphide using the thermoluminescence technique and the thermally stimulated current technique. It is concluded that trapping centres responsible for the thermoluminescence peaks at 123 and 156°K and associated with blue luminescence can empty at least partially via the conduction band rather than exclusively by a non-conduction band process, as previously suggested. (auth)

23407 NANOSECOND RELAXATION OF THE CONDUCTIVITY AND THE LUMINESCENT SPECTRA OF IONIC CRYSTALS DURING SUPERDENSE EXCITATION WITH A STRONG ELECTRON BEAM. Vaisburd, D. I.; Shkatov, V. T.; Tavanov, E. G.; Semin, B. N.; Akerman, S. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 6, 1281-1284(Jun 1974). (In Russian).

The conductivity relaxation of alkali halide crystals (NaCl, KCl, RbCl, KBr, and KI) during irradiation with single pulses of the strong nanosecond electron accelerator was studied. The spectra of the nanosecond components of the luminescence contain new bands in addition to the known band of singlet exciton luminescence. It was concluded that at high excitation densities a direct recombination of electrons and holes without intermediary localization predominates. (tr-auth)

23408 APPLICATION OF SAXS TO THE STUDY OF MICROPOROSITY OF GRAPHITIC MATERIALS FOR HIGH-TEMPERATURE NUCLEAR REACTORS. Krautwasser, P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf); Koizlik, K.; Nickel, H.; Koss, P.; Ruland, W. J. Appl. Crystallogr.; 7: No. 2, 223-224(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

Measurements of microporosity changes in graphitic materials for high-temperature reactors— pyrocarbon, graphite and matrix materials— during heat treatment and irradiation were expected to be of interest because of the following reasons: (a) porosity and pore-size distribution seem to be primarily responsible for fission-product transport, (b) irradiation experiments show a strong influence of density, i.e., of porosity, on the irradiation behavior. First investigations showed the presence of a pore-size distribution in the range of about 5 Å (vacancies) up to more than 5000 Å diameter in all these graphitic materials. It can be assumed that there exists a large variety of pore shapes, from spherical to wedge-shaped pores. Study on pyrocarbon: The mechanical behavior of pyrocarbon coating layers during heat treatment and irradiation is partly governed by creep processes. Creep processes are generally explained by stress-directed motion of vacancies or small clusters of vacancies which cause an increase in anisotropy. This should result in an overall change in the pore-size distribution. Therefore the first part of the paper compares changes in texture and pore size distributions. The results are (a) during heat treatment a significant growth of the energetically preferred bigger pores, consuming the small ones, can be noted, (b) the changes in texture increase with increasing concentration in vacancies or small vacancy clusters and internal or external stresses, (c) creep in pyrocarbon leads to a strong decrease in pore concentration of 10 Å pores which in turn should lead to a decrease in creep processes. Study on matrix material and graphite: In contrast to graphite, matrix material additionally contains disordered, non-graphitized binder regions. In these regions an irradiation-induced graphitization takes place at irradiation temperatures far below the usual graphitization temperature. This graphitization leads to a higher order in the binder which should be perceptible by a decrease in vacancy-cluster concentration. The change of microporosity in matrix material and graphite was measured as a function of the dose of fast neutrons. The results are: The concentration of small pores is reduced in the binder by irradiation-induced graphitization. The final value is caused by a balance of two contrarily acting processes. The production of new defects during irradiation leads to a lower state of order in the material. On the other hand, the degree of order increases by the use of irradiation-produced Frenkel defects for atomistic transport processes. Therefore in the low-ordered binder an irradiation-induced graphitization is predominant at low doses. With increasing dose and order an increasing disordering process is superimposed until an equilibrium is reached. The concentration of vacancy clusters therefore decreases to a limiting value. Unlike in matrix material, the order in graphite is reduced; the concentration of vacancy clusters increases from the beginning of the irradiation. (auth)

23409 CLUSTER ARRANGEMENT OF POINT DEFECTS IN γ-RADIATED LiF. Wagner, W.; Waidelich, W.; Wohofsky, O. (Technische Univ., Darmstadt, Ger.). J. Appl. Crystallogr.; 7: No. 2, 224(1 Apr 1974).

From 3rd international conference on small-angle scattering; Grenoble, France (4 Sep 1973).

The clustering of point defects in γ-irradiated LiF single crystals was investigated by measuring the small-angle X-ray scattering after various γ doses. The curves were obtained by means of a Kratky camera on a 30 kW X-ray generator with rotating anode. With increasing irradiation time the scattered intensity shows a maximum at 10^{-2} $Å^{-1}$. It is suggested that this maximum is due to a regular arrangement of the defect clusters. The mean distance is 500 Å. (auth)

23410 RADIATION FORMATION OF CATION VACANCIES IN WHISKERS OF $A^{I}B^{VII}$. Lushchik, Ch. B.; Gindina, R. I.; Pung, L. A.; Tiisler, E. S.; Elango, A. A.; Yanson, N. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 6, 1219-1222(Jun 1974). (In Russian).

The formation of cation vacancies in whiskers of LiF, NaCl, NaBr, KCl, and KBr under the effects of x radiation was studied experimentally. Radiation defects in macrocrystals of the same compounds were also investigated. The experimental data confirmed the formation of cation vacancies. The mechanism of their formation and reaction with other crystal defects is discussed. (JSR)

23411 DISTANCE BETWEEN GENETIC PARTNERS OF RADIATION DEFECTS IN KBr, DETERMINED BY THE PARTIAL LIGHT SUM METHOD. Grabovskis, V. Ya.; Vitol, I. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 6, 1223-1224(Jun 1974). (In Russian).

The density function of the distribution of tunneling partners after optical excitation of samples of KBr and KBr–I was determined. It was shown that the tunneling centers, responsible for the luminescent at $h\nu = 2.6$ and 1.9 eV, are closer together in KBr–I than in KBr. (tr-auth)

23412 LUMINESCENT PROCESSES DURING INTERACTION OF RADIATION DEFECTS WITH LUMINOL. Chertok, F. M.; Matyushkov, V. V.; Mikhal'chenko, G. A.; Lukashev, V. A.; Simikon, L. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 6, 1261-1263(Jun 1974). (In Russian).

The chemoluminescent method of studying radiation defects is based on the registration of the chemoluminescence occurring during the dissolution of irradiated solids in a solution of a chemoluminescent indicator, such as luminol (the hydrazide of 3-aminophthalic acid). The sensitivity of this method for determining the quantity of radiation defects was studied with alkali halides and potassium tartrate irradiated with ^{60}Co γ radiation and β particles from $^{90}Sr + ^{90}Y$, at a dose rate of 10^{15} eV/cm³ sec. Factors affecting the efficiency of the excitation of chemoluminescence reactions in solutions of irradiated solids and luminol were evaluated. (JSR)

23413 SELF-DIFFUSION AND RADIATION DAMAGE IN α-PHOSPHORUS SINGLE CRYSTALS. Hampton, E. M.; McKay, P.; Sherwood, J. N. (Strathclyde Univ., Glasgow). Phil. Mag.; 30: No. 4, 853-868(Oct 1974).

The temperature dependence and pressure dependence of self-diffusion in α-white phosphorus single crystals were redetermined using radiotracer and plastic deformation techniques. Use of ^{32}P-labelled tracer resulted in radiation damage to the solid by the emitted electrons (E_{max} = 1.71 MeV). This led to the evaluation of radiation-enhanced self-diffusion coefficients which show a similar anomalous temperature dependence to that previously reported for self-diffusion in this solid. Repetition of the experiment with ^{33}P-labelled tracer (E_{β} max = 0.24 MeV) yielded normal behavior which could be described by an equation $D = 3.6 \times 10^{5} \exp(-114.4 \pm 2.0$ kJ $mol^{-1}/RT)m^2$ sec^{-1}. The activation energy was confirmed by plastic deformation experiments. Self-diffusion probably occurs by a vacancy migration mechanism. Studies of the pressure dependence of the self-diffusion process yield activation volumes which indicate that there may be a significant contribution to the process from di-vacancy migration. (auth)

23414 EXPLORATORY STUDY OF CATALYTIC OXIDATION REACTIONS ON VANADIUM PENTOXIDE SINGLE CRYSTALS. Colpaert, M. N. (Ghent Rijksuniversiteit (Belgium). Lab. voor Kristallografie en Studie van de Vaste Stof). Z. Phys. Chem. (Frankfurt); 84: No. 1-4, 150-156(Mar 1973).

In a study of the oxidation of propene and butenes on the (010) surface of vanadium pentoxide single crystals, the catalytic activity was measured and the nature of the catalyst oxide form was analyzed by X-ray diffraction. The results indicate that fully oxidized vanadium pentoxide shows no catalytic activity, and that V_6O_{13} is involved in the catalytic process of selective oxidation. Vanadium dioxide, on the other hand, favors complete oxidation to carbon dioxide and water. (auth)

23415 FISSION PRODUCT TRANSPORT THROUGH MATRIX GRAPHITE. P. 1. Transport of Active and Inactive Strontium. Hattenbach, K.; Melkonian, G. A.; Ruckdeschel, A.; Willamowski, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Werkstofftechnologie; Hamburg Univ. (F. R. Germany). Inst. fuer Physikalische Chemie). Z. Phys. Chem. (Frankfurt); 87: No. 1-3, 94-103(Nov 1973). (In German).

Penetration of strontium out of a cylindrical source (diameter = 0.8 mm), located in the middle of a graphite cylinder (diameter = 5 mm) into the surroundings was investigated isothermally within a temperature range of $850 \leq T \leq 1{,}150°C$ and diffusion times being $0.16 \leq t \leq 90$ hours. To find out concentration profiles, the strontium contents in the turned-off graphite layers were determined at high Sr concentration of the source by means of atomic absorption, and at low concentrations when operating with ^{85}Sr as tracer by activity measurements. To evaluate experimental data, the connection between Einstein's displacement square with the diffusion coefficient was applied. From the temperature

dependence of the coefficient an activation energy of 59 ± 3 kcal for the transport phenomenon, according to the Arrhenius equation, could be calculated. (auth)

23416 PARAMAGNETIC PROPERTIES OF SOME TERNARY RARE EARTH COMPOUNDS. Drofenik, M.; Zupan, J.; Kolar, D. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Z. Naturforsch., b; 29: No. 9/10, 614-615(Sep 1974).

Some paramagnetic properties are given for a number of ternary rare earth compounds isomorphous with Sr_2EuFeO_5. Temperature variation of magnetic susceptibility obeys the Curie-Weiss law with exceptions for europium and samarium. Magnetic moments exhibited are close to that theoretically expected for the free ion except for europium whose value is a little higher. (auth)

23417 ESR AND OPTICAL ABSORPTION STUDIES ON IRRADIATED $Ba(ClO_3)_2 \cdot H_2O$ SINGLE CRYSTALS. Suryanarayana, D.; Sobhanadri, J. (Indian Inst. of Tech., Madras). J. Nonmetals; 2: No. 2, 113-121(Mar 1974).

Single crystals of $Ba(ClO_3)_2 \cdot H_2O$, grown from aqueous solution, are exposed to uv, x- and γ-radiations and the induced magnetic centers are studied by optical absorption and electron spin resonance. The optical bands located at 280, 323 and 515 mμ are attributed to the diamagnetic radicals ClO_2^-, ClO^- and Cl_2O_6 respectively. Two paramagnetic centers ClO_2 and O_3^- with optical absorption around 350 and 435 mμ respectively are found from esr studies to be trapped at two magnetically inequivalent sites in the crystal. The principal values of the g-tensor for O_3^- are reported along with those obtained from the powder pattern and are found to have an average g-value of 2.0087. Optical dichroism studies are also carried out to determine the direction of polarization of these bands. The visible band at 515 mμ is attributed to Cl_2O_6 formed from dimerization of the ClO_3 molecule. (auth)

23418 ROLE OF DEFECT CHARGE STATE IN THE STABILITY OF POINT DEFECTS IN SILICON. Kimerling, L. C. (Bell Telephone Labs., Inc., Murray Hill, NJ); DeAngelis, H. M.; Diebold, J. W. Solid State Commun.; 16: No. 1, 171-174(1 Jan 1975).

Defect annealing in 1-MeV electron-irradiated, phosphorus-doped silicon is studied. Charge state effects are explored directly using a p-n junction structure. A defect state which is associated with the E center (phosphorus-vacancy pair) is found to disappear at approximately 150°C with an activation energy of 0.95 ± 0.03 eV in the neutral charge state and 1.25 ± 0.05 eV in the negative charge state. (auth)

23419 EPR EVIDENCE OF THE SELF-INTERSTITIALS IN NEUTRON-IRRADIATED SILICON. Lee, Y. H.; Corbett, J. W. (State Univ. of New York, Albany). Solid State Commun.; 15: No. 11-12, 1781-1784(15 Dec 1974).

Detailed studies on the Si – P6 spectrum show that the spectrum has an unusual g-tensor symmetry (monoclinic II) and a large stress alignment ($n_\perp/n_\parallel = 17$). A number of defect models for this spectrum were considered; two (⟨100⟩ split-interstitial and ⟨100⟩ di-interstitial) are briefly discussed. The ⟨100⟩ di-interstitial is the preferred model. (auth)

23420 TITANIUM CENTRE INDUCED IN IRRADIATED ALKALI DIBORATE GLASSES. Arafa, S. (American Univ., Cairo). Phys. Chem. Glasses; 15: No. 2, 42-46(Apr 1974).

The optical absorption spectra of alkali diborate glasses containing small concentrations of TiO_2, both before and after x-ray irradiation at room temperature, was observed using a Beckman DK spectrophotometer. The induced spectra were resolved with a NCR 200 computer and compared with those of the base glasses containing no titanium. A new induced optical absorption band at about 2.4 eV with a half width of 1.0 eV, was found in the spectra of irradiated glasses which contain <0.3 mol% TiO_2. It is suggested that this band, denoted T_2, is due to a photo-induced centre according to the reaction. $Ti^{4+} + e \rightarrow [Ti^{4+} + e] - (T_2$ centre). The appearance of the T_2 centre is associated with a drastic decrease in the intensity of the [A] band, which is characteristic of high alkali borate glasses. This optical band is correlated with the induced sharp asymmetric ESR line published earlier for the same glasses. Both optical and ESR results indicate that the T_2 centre is associated with the presence of titanium in the glass network and is of high tetragonal distorted octahedral symmetry. The energy splitting values, Δ and δ, for this centre in potassium diborate glass was calculated to be: $\Delta = 1.955 \times 10^4$ cm^{-1} (2.42 eV), $\delta = 1.136 \times 10^4$ cm^{-1} (1.40 eV). A possible model for the T_2 centre is given. (auth)

23421 ROLE OF HYDROGEN AND DEUTERIUM ON THE V^-–CENTER FORMATION IN MgO. Chen, Y.; Abraham, M.M.; Templeton, L.C.; Unruh, W.P. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. B, 11: No. 2, 881-890 (15 Jan 1975).

The formation of the V^- center in MgO by ionizing radiation is found to be contingent on the presence of an impurity: hydrogen. The attainable V^- concentration is dependent upon the initial V^-_{OH} concentration detected by the 3296–cm^{-1} infrared absorption band. A similar dependence on the V^-_{OD} concentration (2445–cm^{-1} band) in deuterated crystals is also observed. Photographs illustrate that the V^- density distribution for a given crystal is identical to that for the V_{OH} center in the same crystal. Quenching crystals, as compared with slow cooling, leads to larger V^-_{OH} or V^-_{OD} bands and, upon intense electron irradiation, results in larger V^- concentrations. As the V^- concentration is enhanced by electron irradiation, the V_{OH} and V^-_{OH} concentrations diminish and ultimately vanish at doses of $\sim 1 \times 10^{18}$ e/cm^2. Hydrogen–free (or deuterium–free) crystals are immune to V^-–center formation, regardless of thermal treatment. The experimental evidences can be understood on the basis of a formation mechanism which involves the displacement of hydrogen from the V^-_{OH} site by ionizing radiation. The enhancement of the infrared absorption bands at 3700 and 2723 cm^{-1} in certain crystals due to electron irradiation indicates that some of the displaced hydrogen and deuterium ions form $Mg(OH)_2$ and $Mg(OD)_2$ precipitates, respectively. (auth)

23422 INFLUENCE OF IMPLANTED DOSE ON THE RECRYSTALLIZATION OF Si AMORPHOUS LAYER. Baeri, P.; Campisano, S.U.; Ciavola, G.; Foti, G.; Rimini, E. (Istituto di Struttura della Materia del Università Catania, 57 Corso Italia, 95129–Catania, Italy). Appl. Phys. Lett. 26: No. 4, 154-155 (15 Feb 1975).

The channeling effect technique has been used to investigate the annealing of the "amorphous" layer produced in Si by 40–keV Pb implants with fluences ranging between 5×10^{13} and 5×10^{15} ions/cm^2. The amount of residual disorder, after an anneal of 30 min at 650 °C, shows a dose dependence and increases strongly with Pb fluence, thus indicating the influence of the dissolved lead atoms in the recrystallization process. (auth)

23423 DEGRADATION EFFECT OF ELECTRON–GUN EVAPORATION ON DIODE CHARACTERISTICS. Wei, L.S. (Atomic Energy of Canada Limited, Commercial Products, P. O. Box 6300, Station "J", Ottawa, Ontario, K2A 3W3, Canada). J. Appl. Phys. 46: No. 2, 949-951 (Feb 1975).

Degradation in the I–V characteristics of large–area silicon junction diodes on which a passivating layer of alumina has been deposited by e–gun evaporation is shown to exhibit symptoms of a shortened recombination lifetime. After a simple heat treatment, the original characteristics may be restored. It is believed that the combined effects of the high–intensity radiation produced by the e–gun during evaporation, and traces of the etching solution on the diode surface are responsible for the observed degradation. (auth)

23424 BURIED OPTICAL WAVEGUIDES IN FUSED SILICA BY HIGH–ENERGY OXYGEN ION IMPLANTATION. Rao, E.V.K.; Moutonnet, D. (Centre National d'Etudes des Télécommunications 22301 Lannion, France). J. Appl. Phys. 46: No. 2, 955-957 (Feb 1975).

Oxygen ion implantations in fused silica in the energy range 0.3–2 MeV with doses ranging from 10^{14} to 10^{16} ions/cm^2 are conducted at room temperature. The optical parameters of the guides obtained are measured before and after successive annealings with the help of a prism–film coupler. Also, an investigation of the buried nature of these guides is carried out by conducting the above measurements before and after removing a known thickness of the implanted layer by argon plasma etching. It is reported that the contribution to refractive index increase in the surface region due to ionization effects cannot be ignored during the realization of buried guides by high–energy ion implantation. Also, it is shown that these guides get buried depending on the annealing treatment. (auth)

23425 DIRECT COMPARISON OF ION–DAMAGE GETTERING AND PHOSPHORUS–DIFFUSION GETTERING OF Au IN Si. Seidel, T.E.; Meek, R.L.; Cullis, A.G. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 46: No. 2, 600-609 (Feb 1975).

The residual disorder caused by different implanted ions after annealing at elevated temperatures (850–1150 °C) is dependent upon the ion species. The gettering of Au by damaged layers produced by Ar, O, P, Si, As, and B has been quantitatively compared to gettering by phosphorus diffusion. Each individual comparison was made between opposite surfaces of a Si sample by use of Rutherford backscattering. The damage disorder was quantitatively measured by backscattering and structurally studied using electron microscopy. Typically, an ion dose of 10^{16}/cm^2 and ion energy of 200 keV were used for implantations. The Au was present in the Si at "moderate" levels so that solubility in the phosphorus diffused layers was not exceeded. Ar ion–damaged layers were more effective for gettering Au than were phosphorus–diffused layers below ~1000 °C and equally effective up to 1150 °C. The relative gettering efficiency of the damage produced by other ions studied was

less than that of phosphorus diffusion at 1000 °C and was ranked in the order Ar $\gtrsim$ O > P > Si > As $\gtrsim$ B. In general, the relative gettering efficiency of ion–damaged layers was related to the amount and type of disorder after annealing. The initial disorder was of an amorphous nature for 10^{16} heavy ions/cm^2 (As, Si, P, Ar, or O), and the final disorder state was different for different implanted ions after annealing. It is suggested that the disorder (and gettering efficiency) was influenced by size effects of the implanted ion during annealing. (auth)

23426 INDUCED ABSORPTION AND THERMOLUMINESCENCE OF LEUCOSAPPHIRE AND RUBY AFTER ELECTRON IRRADIATION. Bessonova, T.S.; Stanislavskii, M.P.; Tumanov, V.I.; Khaimov–Malkov, A.V.Ya. Opt. Spectrosc. (USSR) 37: No. 4, 398-400 (Oct 1974).

The kinetics of the formation of induced color centers in leucosapphire and ruby due to fast electron irradiation is investigated, the dependence of thermoluminescence curves on the radiation dose is given, and the relationship between thermoluminescence and induced–absorption peaks is discussed. (auth)

23427 DEFECTS ON RbI-SINGLE CRYSTALS INDUCED BY X-RAYS. Kohn, E.; Staude, H. Z. Phys. Chem. (Frankfurt); 84: No. 1/4, 173-187(Mar 1973). (In German).

In the X-ray irradiation of pure RbI, bands were found which previously were found in other alkali halides, but not in RbI; also found were bands which have never occurred in any alkali halide, even when doped with halogens. The behavior of these bands under irradiation with light of various energy as well as with annealing was investigated and the correlation to crystal defects discussed. (GE)

23428 MICROSTRUCTURE OF XENON–IMPLANTED SILICON. Mader, S.; Tu, K.N. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Vac. Sci. Technol. 12: No. 1, 501-503 (Jan 1975).

Si implanted with 10^{14}, 10^{15}, and 5×10^{15} ions/cm^2 of 80 KeV Xe ions was examined by electron microscopy and nuclear backscattering. Implantation created amorphous Si, which, after annealing at 700°C, transformed into single crystal material for doses $\leq 10^{15}$/cm^2 and into a heavily twinned material for the higher dose. Under suitable conditions, such implants can be used as diffusion markers in the study of surface reactions. (auth)

23429 CRYSTAL ORIENTATION DEPENDENCE OF RESIDUAL DISORDER IN As–IMPLANTED Si. Müller, H.; Chu, W.K.; Gyulai, J.; Mayer, J.W. (California Institute of Technology, Pasadena, California 91125); Sigmon, T.W.; Cass, T.R. Appl. Phys. Lett. 26: No. 6, 292-294 (15 Mar 1975).

MeV $^4He^+$ channeling effect measurements combined with transmission electron microscopy (TEM) and Hall effect measurements were employed to study the orientation dependence of the amount of damage remaining after anneal of 200–keV As–implanted Si. The residual disorder after high–temperature annealing was found to depend upon the crystal orientation. For ⟨111⟩–oriented Si, anomalously high residual disorder was found in the dose region of 10^{15}/cm^2 by both the TEM and channeling measurements. Significantly less disorder was found in ⟨100⟩– and ⟨110⟩–oriented Si, the latter exhibiting essentially no residual disorder. The electrical activity of the implanted layer was consistent with the orientation dependence observed. (auth)

23430 BASIC REQUIREMENTS FOR PLASTICS AND PAINTS USED IN NUCLEAR LABS AND FACILITIES. Com. Naz. Energ. Nucl., Notiz.; 20: No. 11, 74-75(Nov 1974). (In Italian).

Draft Standards developed by a UNICEN Working Group and approved by UNI's Nuclear Energy Committee in April 1974 are presented. (auth)

23431 FORMATION OF RADIATION DEFECTS IN NaCl AND KCl MONOCRYSTALS IRRADIATED BY ELECTRONS AT 10 TO 50 KEV DURING CHANNELING OF THE BOMBARDING PARTICLES. Kuleshov, E. A.; Shipatov, E. T. (Donetsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 82-85(1974). (In Russian).

The process of formation of F centers in NaCl and KCl monocrystals during irradiation by 10 to 50-keV electrons was studied under conditions where the incident electron beam was oriented at different angles to the 100 crystalline axis of the monocrystals. It was shown that during channeling of the electrons the rate of formation of F centers was increased and the concentrations of F centers near the surface of the crystals increased. The relation of the observed orientation phenomenon in the formation of F centers with the irradiation dose and the initial electron energy was established. The characteristic angles for electron channeling were determined. (tr-auth)

23432 THERMOLUMINESCENCE OF $CaSO_4$ DOPED WITH RARE EARTHS. Nambi, K. S. V.; Bapat, V. N.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). J. Phys., C (London); 7: No. 23, 4403-4415(7 Dec 1974).

The influence of rare-earth (RE) impurities as well as the host ions in the thermoluminescence (TL) of $CaSO_4$ phosphors was studied in detail by recording the TL glow curves, TL emission spectra, and ESR spectra of a number of gamma-irradiated $CaSO_4$ samples doped individually with different elements of the lanthanide series. It is concluded that: (1) Dy and Tm are the most efficient activators of TL in $CaSO_4$ and follow the well known concentration quenching law; (2) radicals like SO_4^-, SO_3^-, O_3^- etc, produced by gamma irradiation, form stable trapping sites of varying activation energies which are responsible for the multipeak TL glow curves exhibited by $CaSO_4$ phosphors; (3) the temperatures of occurrence of the various glow peaks remain remarkably constant irrespective of the RE dopant and are directly proportional to the activation energies of the respective traps; and (4) the TL emission spectra correspond to the fluorescence emission of RE^{3+} ions. A possible model for the process of TL in $CaSO_4$ (RE) is also discussed. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 22006.

23433 DESTRUCTIVE METHODS APPLIED IN SAFEGUARDS TECHNIQUES. Ionescu, V. (Comitetul de Stat pentru Energia Nucleara, Bucharest). Stud. Cercet. Fiz.; 26: No. 4, 391-405 (1974). (In Rumanian).

The methods that meet the exigencies of a modern safeguards system in a nuclear fuel cycle have proved to be, up to now, the destructive analytical control methods of fissile and fertile materials. The content of uranium and plutonium can be determined by the methods shown in the paper, i.e., gravimetric, titrimetric, coulombmetric, mass-spectrometric and others both in samples of unirradiated fuel (from the fabrication plant), and in samples of irradiated fuel (from the reprocessing plant). From the comprehensive existing publications these were chosen methods and techniques, which by their accuracy, assure the object of safeguards. The mass-spectrometric isotopic-dilution analysis of uranium and plutonium in solutions of nuclear fuel is now the best and most used method. (auth)

23434 VIENNA IN PANIC ABOUT RADIOACTIVE RADIATION. Three Attacks in One Week–Is the Anonymous Criminal an Insane Scientist? Pollak, K. Welt (Hamburg); No. 93, 20(Apr 1974). (In German).

A vicious criminal who uses radioactive substances as a weapon of terror has for a week caused the Austrian public anxiety and panic. The criminal, who up to now has always telephoned the authorities about his radiation outrages, is believed to be an expert who has perfect knowledge about handling radioactive material. (auth)

23435 INTERNATIONAL CONTROL OF THE EUROPEAN NUCLEAR INDUSTRY. History and Functions of the Agreement of April 5, 1973. Kimminich, O. (Regensburg Univ. (F. R. Germany)). Z. Ausl. Oeff. Oeffentliches Recht Voelkerrecht; 33: No. 4, 636-672(Dec 1973). (In German).

In implementation of article III(1) and (4) of the non-proliferation treaty the non-nuclear members of Euratom, together with Euratom itself, have finally concluded an agreement with the International Atomic Energy Agency, thus opening the way for the ratification of the non-proliferation treaty in these countries. The agreement adds a new layer of control to the already complicated control of the peaceful uses of the atom in Western Europe. The report outlines the existing systems–of Euratom, ENEA, WEU and IAEA–and traces their respective scopes and interrelationships. Then it shows the importance of IAEA-controls for the non-proliferation treaty and the difficulties arising from the fact that those Western European countries which according to that treaty are to be controlled by IAEA are already subject to Euratom controls. The agreement of 5 April 1973 solved these problems by integrating the Euratom controls into the IAEA system and by restricting the latter's functions essentially to the task of verification. Its main objectives were to avoid any unnecessary duplication of safeguard activities on the one hand, and to guarantee effective safeguards on the other. Both aims had to be reached without creating unfavorable working conditions for the nuclear industries of the countries involved and without infringing upon the inalienable right of all states to develop research, production and use of nuclear energy for peaceful purposes without discrimination. The report shows that the verification agreement meets all these demands. (auth)

Disposal and Storage

Refer also to abstracts 22152, 22156, 22595, 22614, 22615, and 22621.

23436 (JAERI-M-5779) SAFETY ASSESSMENT OF THE RADIOACTIVE WASTE-CEMENT COMPOSITES. I. Leaching of ^{137}Cs FROM SOLIDIFIED CEMENT BLOCKS. Emura, S.; Matsuzuru, H.; Hisa, I.; Seki, S. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 36p. (In Japanese). Dep. NTIS (US Sales Only).

The leaching of ^{137}Cs from a solidified waste into the environmental water was studied to evaluate the safety for sea disposal of the radioactive waste-cement composites. The leaching test was carried out following the method recommended by IAEA. The samples tested were prepared by incorporating simulated liquid wastes from BWR and/or PWR into the cement (portland or portland blast-furnace slag cement) with or without aggregates. The leaching ratio was measured as functions of Wa/C (the waste-cement ratio), concentration of salts (BWR; Na_2SO_4, PWR; Na_3BO_3) and ^{137}Cs, content of aggregates, temperature of leachant, and setting time. The results obtained can be summarized as follows: the leachability of ^{137}Cs is lowered by using p.b. slag cement for BWR's waste, and by portland cement for PWR's; the leaching ratio is lowered with decrease of both Wa/C and salt concentration; at low temperature, the setting period of cement affects significantly the leachability; and the leachability of ^{137}Cs is lowered remarkably by addition of zeolite to the composites. (auth)

23437 (NP-20310) GUIDELINES FOR SEA DISPOSAL PACKAGES OF RADIOACTIVE WASTE. (Nuclear Energy Agency, 75–Paris (France)). Nov 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

NEA Guidelines are presented which define requirements for packages of radioactive waste intended for sea disposal to ensure that all stages of their handling, transportation and dumping into the deep sea are carried out safely, provide guidance for the design, manufacture and assembly of sea disposal packages, and assist national competent authorities in issuing the special permits required by the London Convention for the dumping of radioactive materials. These Guidelines cover the design, manufacture, assembly, handling and transport of packages for solid or solidified radioactive wastes, insofar as they are relevant to deep sea dumping. They are limited to technical considerations and do not cover the organization and approval of sea dumping operations, in particular the transport arrangements which will have to be approved by the national competent authorities, and the special permits required under the London Convention for the dumping of radioactive waste. To help interpret these Guidelines, several types of sea disposal packages in use in NEA Member countries are given in Annex I as examples of existing practices. (auth)

23438 SUMMARY OF LOW-LEVEL RADIOACTIVE WASTES BURIED AT COMMERCIAL SITES BETWEEN 1962–1973, WITH PROJECTIONS TO THE YEAR 2000. O'Connell, M. F.; Holcomb, W. F. (Environmental Protection Agency, Washington, DC). Radiat. Data Rep.; 15: No. 12, 759-767(Dec 1974).

The U. S. Environmental Protection Agency contracted with the six states having commercial burial facilities for low-level radioactive wastes to obtain inventories of the types and quantities of wastes buried at these six sites. A compilation and interpretation of the inventory data is presented in tables and figures. Projections are made to the year 2000 of the quantity of low-level radioactive wastes that will result from the nuclear fuel cycle and nonfuel cycle sources. In addition, assumptions are made relating these projections to the available capacity and operational life of the commercial sites. Based on estimates of waste generation rates, it is indicated, assuming present operational practices, that by the year 1998, the six existing sites will exhaust their current burial capacity. (auth)

Handling Equipment and Procedures

Refer also to abstract 22962.

Transportation

23439 (ANSC-CSK12-A897) NUCLEAR SPENT FUEL SHIPPING CONTAINER/CASK STUDY FOR NUCLEAR CENTRAL STATION POWER PLANT BUSINESS. Johnson, C. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 36p. Dep. NTIS $5.00.

The market for fuel shipping containers to serve the projected fuel transport requirements for the U. S. nuclear power industry was studied with emphasis on the market for spent fuel shipping casks. The container study produced the following information: the potential market for spent fuel shipping casks thru 1980 ranges from $35 to 45 M; yearly sales of $5.5 $\overline{M}$ to $6.5 $\overline{M}$ are anticipated in the mid 1970's; design, licensing and fabrication of casks require minimum of three years lead time; Aerojet Nuclear Systems Co. (ANSC) is currently in the spent fuel shipping cask business per FFTF and LMFBR Programs; fuel reprocessors have indicated a desire to work with ANSC; and the greatest effort should be expended on rail mounted casks. (auth)

23440 (BNWL-SA-5106) RADIATION PROBLEMS ASSOCIATED WITH HIGH EXPOSURE PLUTONIUM TRANSPORTATION. Faust, L. G.; Brackenbush, L. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. 7p. (CONF-740901-18). Dep. NTIS $4.00.

From 4th international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

The radiation problems associated with the shipment of Pu from a fuel reprocessor to a reactor fuel fabricator are reviewed. It is concluded that heat loads and radiation levels associated with high exposure plutonium will require many changes in the current shipping practices. The incorporation of neutron shielding is expected to be mandatory as will the redesign of containers to accommodate increased heat loads. These kinds of problems plus those of safeguards and the handling and transporting of alpha contaminated wastes, when considered in toto, support the nuclear park concept wherein onsite facilities preclude the transportation of plutonium over long distances. (LCL)

23441 (NDS-23) LMFBR FUEL SHIPPING STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Jul 1970. Contract (04-3)-782. 71p. Dep. NTIS $6.75.

The objective of the study was to review pertinent literature with respect to fuel assembly weight, dimensions, fuel and blanket material distribution, and expected fission products to aid in the design of a shipping cask for LMFBR and FFTF fuel elements. A summary of the problem areas in the design of the LMFBR Spent Fuel Shipping Cask System and some preliminary analyses results are given as an introduction to a "Reference Model" cask concept. The "Reference Model," which will serve as a basis for evaluation and design criteria development, is described along with suggested reactor plant and fuel reprocessing plant facility and equipment requirements. (TFD)

23442 (ORNL-TM-4720) CONCEPTUAL DESIGN OF PACKAGES FOR SHIPPING SOLUTIONS CONTAINING ^{239}Pu AND ^{233}U. Shappert, L. B.; Ulrich, W. C. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 45p. Dep. NTIS $5.25.

Packages intended to be used for the shipment of aqueous nitrate solutions containing ^{239}Pu and ^{233}U must satisfy the same requirements as packages for shipping other forms of radioactive material, such as those related to heat transfer, shielding, and criticality; in addition, other factors which must be considered are potentially high generation rates of radiolytic gases with attendant pressure buildup and hydrogen-oxygen reaction possibilities, material compatibility, and operational requirements. This report discusses these problems in terms of their effects on the design of packages for shipping plutonium and uranyl nitrate solutions and describes a concept for an improved package capable of solving them. (auth)

23443 (TID/SNA-341) LMFBR FUEL SHIPPING CASK SYSTEM EVALUATION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Oct 1970. Contract (04-3)-782. 86p. Dep. NTIS $7.50.

The objective of the LMFBR Fuel Shipping Cask System Evaluation was to evaluate and refine the Reference Model LMFBR Cask which was described in Aerojet Nuclear Systems Report NDS-23 dated 15 July 1970. This work is leading to the next milestone of preparing Design Characteristics to guide the design of a licensable cask "suitable for and on a schedule compatible with the first shipment of FFTF fuel for reprocessing on 1 January 1975." The cask must also be compatible with fuel shipments from early LMFBR Demonstration Plants. Shielding, thermal and mechanical analyses were done using the Reference Model Cask to identify the parameters of concern for quantitative evaluation. In addition preliminary operational analyses relative to loading and unloading of the cask was performed to identify equipment, facility and operational requirements. Suggestions for the Reference Model Cask have been received and, as appropriate, incorporated into a refined concept which provides for enhanced utility, safety and economy. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 22775 and 24646.

23444 (AD-784333) DESIGN PRINCIPLES AND POSSIBLE APPLICATION OF ACCELERATORS WITH A SUPERSTRONG MAGNETIC FIELD PRODUCED BY A DETONATION. Panasyuk, V. S.; Sokolov, A. A.; Stepanov, B. M. Translated from At. Energ. (USSR); 33: No. 5, 907-912(14 May 1972). 15p. (FSTC-HT-23-1413-73). NTIS $4.00.

Several designs of single-shot accelerators having ultrahigh magnetic fields generated by magnetocumulative generators are presented. Betatron and high-frequency cyclic accelerators, as well as direct-action accelerators, are considered. Various methods of particle injection and extraction are described. Possible applications of the cyclic accelerators described are assessed for obtaining superhigh-energy particles. Such accelerators seem promising for the acceleration of beams of secondary particles, as well as for experiments on μ-meson and π-meson intersecting beams, of fundamental importance for high-energy physics. (auth)

23445 (AD-787053) SOVIET DEVELOPMENT OF FLASH X-RAY MACHINES. Kassel, S. (Rand Corp., Santa Monica, Calif. (USA)). Oct 1973. 20p. (R-1053-ARPA). NTIS $3.25.

The material on Soviet development of high-power flash x-ray machines was prepared from Soviet and U. S. open-source publications covering the period from 1968 to 1973, and represents a significant aspect of the continuing study of high current beams developed in the Soviet Union. The designers of the RIUS electron accelerator series are developing new machines with pressurized water as the dielectric. The physical properties of water make it superior in this application to conventional materials, such as oil, offering the opportunity to achieve higher power levels and pulse repetition rates. Flash x-ray machines in which x-ray excitation occurs at near atmospheric pressures are being considered. (auth)

23446 (LA-5845-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending October 31, 1974. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 104p. Dep. NTIS $5.45.

The continued development and performance testing of the accelerator components, instrumentation, and computer systems are reported. The accelerator was in operation for the entire quarter, and activities in the experimental areas are summarized. A total of 40 experiments had data-taking runs during the quarter. A section devoted to management concerns is included, and a bibliography of LAMPF-related publications is given. (WHK)

23447 IN ACTION AGAIN: THE 600 MeV SYNCHRO-CYCLOTRON. CERN Cour.; 15: No. 2, 31-34(Feb 1975).

The CERN 600-MeV synchrocyclotron has given its first protons for physics experiments following the major reconstruction of the machine during the past two years. The improvement program is described; and the present performance, the future beams, and the experimental program are discussed. (WHK)

23448 ELECTROSTATIC ACCELERATORS. Allen, K. W. (Nuclear Physics Lab., Oxford). pp 3-34 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Some of the design and construction principles common to all electrostatic generators are reviewed, and the design and operation of tandem accelerator are described. Also, tandem accelerators for heavy ion acceleration are discussed. (WHK)

23449 CYCLOTRON. Harvey, B. G. (Univ. of California, Berkeley). pp 35-77 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

A brief history of the cyclotron is given, and particle dynamics in the cyclotron were studied. The frequency modulated cyclotron and the AVF cyclotron were examined, and ion sources are described. Also, the use of AVF cyclotrons as research tools is discussed. (WHK)

23450 SPECIALIZED ACCELERATORS: HEAVY ION ACCELERATORS. Bock, R. (GSI, Darmstadt, Ger). pp 79-111 Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Some fundamental facts of atomic and nuclear physics on which the design of heavy ion accelerators is based including required beam properties, charge-changing processes, and production of highly charged ions are presented. Different concepts of universal heavy ion accelerators and some new accelerator concepts which may be important for future development are presented. (WHK)

23451 SPECIALIZED ACCELERATORS: ELECTRON LINEAR ACCELERATORS. Schwettman, H. A. (Stanford Univ., CA). pp 129-147 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The fundamental problems in the design and operation of electron linacs are discussed; and recent developments in electron linacs including high power klystrons, precisely tuned copper accelerator structures, and superconducting electron linacs are reviewed. (WHK)

23452 INDUSTRIAL HYGIENE AND SAFETY CONTROLS AT A 1.5 MeV ELECTRON BEAM ACCELERATOR FACILITY. Kortsha, G. X. (General Motors Corp., Warren, MI). Amer. Ind. Hyg. Ass. J.; 36: No. 2, 154-158(Feb 1975).

Radiological safety measures built into a 1.5 MeV electron beam accelerator at the General Motors Research Laboratories are discussed. The accelerator is used to study the interaction of electrons with plastic materials. The safety features described represent the type of precautions taken over and above legal requirements and include the results of experience gained in other installations. (auth)

23453 2-MV PULSED ELECTROVACUUM INSTALLATION. Kalyatskii, I. I.; Kassirov, G. M.; Smirnov, G. V. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1032-1034(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 84-86(1974).

An experimental installation is described for investigating electrical breakdown in a vacuum of up to 10^{-5} torr at pulse voltages of up to 2 MV. The length of the vacuum gap reaches 16 cm. (auth)

23454 USE OF CORELESS INDUCTORS FOR OBTAINING AND TRANSPORTING AN ELECTRON BEAM HAVING A PULSE CURRENT OF UP TO 25 kA. Pavlovskii, A. I.; Gerasimov, A. I.; Tananakin, V. A.; Dubinov, E. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 951-955(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 23-26(1974).

The accelerating voltage of a group of inductors was concentrated onto a diode electron gun with a cold cathode made of Ta foil 20 to 100 μ thick. The mutual shielding of the emitters and the shielding of their tops by the cathode holder have been eliminated. A relationship is derived between the beam current and the electric and geometric parameters of the gun in the energy range from 150 to 400 keV. The beam from the gun is transported in a longitudinal magnetic field through a linear induction accelerator in which the electrons were additionally imparted an energy of up to 400 keV. Radial compression of the beam to a diameter of 10 mm was performed by a magnetic field beyond the accelerator. The beam was extracted into the atmosphere. (auth)

23455 SUPERCONDUCTING ACCELERATORS: HIGH ENERGY IS TRAILING LOW ENERGY. Metz, W. D. Science; 187: No. 4181, 1066-1068(21 Mar 1975).

The application of superconducting technology to operating accelerators is reviewed. It is seen that several superconducting linacs in the medium energy range have been successfully constructed; but no operating high-energy synchrotrons have incorporated superconducting cavities or waveguides in their design, although it has been studied and planned. The historical development and recent progress in superconducting cavities are reviewed. (WHK)

Auxiliaries and Components

Refer also to abstract 22757.

23456 (SLAC-Trans-167) CALCULATED CHARACTERISTICS OF $\pi/2$-MODE STANDING-WAVE ACCELERATING STRUCTURES. Andreev, V. G. Translated from Tr. Radiotekh. Inst.; 16: 121-132(1973). 8p. Dep. NTIS $4.00.

Results are presented of computer studies of the geometrical dimensions and rf characteristics of accelerating structures consisting of coupled cavities and operating in the $\pi/2$ standing-wave mode. (auth)

23457 CHARGED PARTICLE BEAM PROFILE MEASUREMENTS. Aframian, A.; Askouri, N. A.; Khan, H. A. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Instrum. Methods; 121: No. 3, 421-424(1 Nov 1974).

This paper describes the use of various plastic and glass solid-state track detectors (SSTD) and other related materials in the measurement of charged particle beam profiles. Attempts have also been made to improve methods of achieving uniform irradiation of samples. (auth)

23458 APPLICATION OF SOLENOID FOCUSSING IN A SUPERCONDUCTING HEAVY-ION LINEAR ACCELERATOR. Jaffey, A. H.; Khoe, T. (Argonne National Lab., Ill. (USA)). Nucl. Instrum. Methods; 121: No. 3, 413-419(1 Nov 1974).

When the resonators of a heavy-ion linear accelerator are operated in the phase-stable region, their inherent radial-defocusing property makes external radial focusing elements necessary for preventing beam blow-up. Although quadrupoles are generally chosen for room-temperature ion linacs for reasons of space and power efficiency, solenoid focusing is superior in superconducting heavy-ion linacs in the energy range of present interest. Since power and cooling requirements are low, for equal beam-optical properties, superconducting solenoids are cheaper and simpler focusing elements than the corresponding quadrupoles. Calculations made for a superconducting-helix linac for heavy ions show that with resonators containing five $\frac{1}{2}\lambda$ sections, the solenoids required are small and use magnetic fields readily attainable in commercial construction. Calculations made with the computer code TRIM show that a relatively small iron shield can be built which reduces the leakage field to negligible values in a relatively short space. (auth)

23459 INVESTIGATION OF A LIQUID TARGET THROWN OFF A FAST ROTATING DISK. Bothur, E. H.; Clausnitzer, G.; Salzborn, E. (Giessen Univ. (F.R. Germany). Abt. Grossgeraete). Nucl. Instrum. Methods; 121: No. 3, 533-535(1 Nov 1974).

The realization of a liquid stripper or target for heavy ion research by flinging high vacuum oil off a fast rotating disk ($\nu \leq 16{,}000$ rpm) was investigated. The oil is thrown off in the form of small droplets with an average diameter of 20 μm. The particle size distribution depends upon instrumental parameters, e.g., frequency and plunging depth of the disk. (auth)

23460 A NEW METHOD OF ACCELERATOR PHASE CONTROL. McKeown, J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 121: No. 3, 509-516(1 Nov 1974).

A new method of phase control is described for use in a 100% duty factor linear accelerator. The method uses a dual channel super-heterodyne receiver, digital phase detector, controller and a tuned analog electronic phase shifter in a closed loop. The system has been used to stabilize the phase of the rf power from a 100 kW cw klystron. (auth)

23461 FOCUSING PROPERTIES OF SUPERCONDUCTING CYCLOTRON MAGNETS. Blosser, H. G.; Johnson, D. A. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Nucl. Instrum. Methods; 121: No. 2, 301-306(15 Oct 1974).

Superconducting main coils combined with conventional sectored iron pole tips constitute a promising design configuration for a new generation of compact, low-cost, heavy-ion cyclotrons. This paper gives results of focusing strength calculations for such cyclotrons for a variety of possible pole tips. The focusing is found to be highly sensitive to the average strength of the magnetic field, moderately sensitive to the magnet gap in the hills, and relatively independent of the number of sectors, the relative width of hill and valley and the magnet gap in the valleys. Spiraling of the magnet pole tips increases the focusing but substantially less than expected. Several of these properties are strikingly different from the corresponding properties of conventional low field magnets. The focusing limit of high field magnets leads to a linear dependence of the energy per nucleon on the charge-to-mass ratio of the ion over much of the operating range which contrasts with the usual quadratic dependence. (auth)

23462 THREE-LENS HEAVY ION BEAM TRANSPORT SYSTEM FOR TERMINALS OF TWO-STAGE (TANDEM) ELECTROSTATIC ACCELERATORS. Mourad, W. G. (National Electrostatics Corporation, Middleton, Wisconsin, USA). Nucl. Instrum. Methods; 121: No. 2, 333-338(15 Oct 1974).

A beam transport system for heavy ions in a terminal of an electrostatic accelerator is described. The system consists of three electrostatic quadrupole lenses and four apertures in series. The first two lenses act as the charge selector and the third lens acts as a matching lens for the high energy tube. Most of the unwanted charge states are filtered down to a background level at least one order of magnitude below the selected charge state level. With ±60 kV supplies the system can be used for ions with energy-to-charge ratio of 2.5 MeV per electronic charge. Whenever less filtering is tolerated, its use may be extended up to about 4 MeV per electronic charge. (auth)

23463 OPERATIONAL 40 kG SUPERCONDUCTING BEAM TRANSPORT MAGNET AND ITS CRYOGENIC SYSTEM. Allinger, J.; Bamberger, J.; Danby, G.; DeVito, B.; DiLullo, C.; Foelsche, H.; Gibbs, R.; Hsieh, S.; Jackson, J.; Prodell, A. Paper No. 74-WA/PID-3. New York; American Society of Mechanical Engineers (1974). 4p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

A superconducting 40 kG magnet system 4 meters long is now operating which bends the 30 billion electron volt primary proton beam produced by the Brookhaven Alternating Gradient Synchrotron. The magnet design is unique in that commercially available niobium titanium composite superconductor and relatively high purity aluminum are used in combination with low carbon steel magnet cores to provide excellent magnetic and thermal stabilization. This magnet system is operating on line in a closed loop, zero loss helium refrigeration system. Details of the magnet structure, dewars, and cryogenic system are discussed. (auth)

23464 ION BEAM PROFILE MONITOR. EerNisse, E.P.; Peterson, G.D.; Schueler, D.G. (Sandia Laboratories, Albuquerque, New Mexico 87115). Rev. Sci. Instrum. 46: No. 3, 266-268 (Mar 1975).

An ion beam profile monitor, which consists of a two-dimensional array of sample points placed in the beam, is described. The monitor provides an accurate and unambiguous display of the beam profile on a laboratory oscilloscope. Performance of the monitor under various ion beam conditions is presented. (auth)

23465 MEASUREMENT OF THE CHARGE OF A PULSED BEAM OF ACCELERATED ELECTRONS. Andreev, A. M.; Borodulin, A. I.; Rybin, V. M.; Tsygankov, E. A.; Tsyplyakov, A. P.; Shestak, V. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 956-958(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 27-29(1974).

A system for measuring the charge of a pulsed electron beam on the U-17 accelerator of the Moscow Engineering-Physics Institute is considered. The system allows measurement of a charge in the $2 \cdot 10^{-12}$–$2 \cdot 10^{-11}$ C range. The accuracy of the measurement is determined by the accuracy of the calibration and the error of the display system, and amounts to 2% when it is used as the output display of a V4-13 digital voltmeter. (auth)

23466 INSTALLATION FOR INVESTIGATING THE ACCELERATION OF ELECTRONS IN SUPERCONDUCTING ACCELERATING SYSTEMS. Biller, E. Z.; Zlunitsyn, E. S.; Zykov, A. I.; Kushnir, V. A. (Inst. of Physics and Tech., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 940-943(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 15-17(1974).

An installation is described for investigating the acceleration of electrons in superconducting accelerating systems. The installation consists of a cryostat into which the tested accelerating system is placed, an electron gun with an energy rating of up to 60 keV and a beam current of up to 20 μA, and a system for measuring the beam parameters. The installation was used to investigate an accelerating system consisting of a cylindrical superconducting resonator operating on the oscillation model E_{010}. (auth)

Ion Sources and Injection and Extraction Systems

23467 (CEA-N-1770) STUDY OF THE NEGATIVE HELIUM ION SOURCE OF THE BRUYERES-LE-CHATEL TANDEM VAN DE GRAAFF. Aubert, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Nov 1974. 39p. (In French). Dep. NTIS (US Sales Only) $4.50.

A negative ion source for helium has been installed since 1969 at the 12 MeV tandem Van de Graaff accelerator of the Service de Physique Nucléaire, Centre d'Etudes de Bruyères-le-Châtel. The source is of the charge exchange type employing Li vapor. After a brief description of the source and the operating characteristics, several modifications which improve its reliability are indicated. Then the results of a systematic study of source operation are presented. The source now operates quite satisfactorily. An important future modification will be to develop preinjection acceleration. This will improve beam quality and enable a reduction of the burst width when the source operates in the pulsed mode. (auth)

23468 DIRECT EXTRACTION OF A $^{12}C^-$ BEAM FROM A DIODE ION SOURCE. Eck, J. S.; Elliott, D. O. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Nucl. Instrum. Methods; 121: No. 2, 411-412(15 Oct 1974).

The standard technique for production of ^{12}C beams with the direct-extraction diode ion source involves introducing a mixture of methane and nitrogen gas into an intense hydrogen arc. The CN^- ion can then be extracted and produces a high intensity beam (1 to 3 μA) for injection into a tandem Van de Graaff accelerator. For achieving high energy ^{12}C beams the CN^- beam suffers from the fact that the stripping at the terminal of the Van de Graaff yields only low intensity beams of the high charge states of C. The successful direct extraction of a C^- beam from a High Voltage Engineering Corporation diode ion source is described. (auth)

23469 POLARIZATION EXPERIMENTS: POLARIZED BEAMS. Haeberli, W. (Univ. of Wisconsin, Madison). pp 151-191 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The basic theory and terminology of polarized beams are discussed. Polarized ion sources, polarized electron sources, and the acceleration of polarized beams were studied. Also, absolute beam polarization calibration is described, and experimental methods in polarization experiments are discussed. (WHK)

23470 DEVELOPMENT OF A SOURCE OF POLARIZED PROTONS AND DEUTERONS FOR THE BONN CYCLOTRON. Schumacher, W. (Bonn Univ. (F. R. Germany). Mathematisch-Naturwissenschaftliche Fakultaet). 31 Jan 1973. 210p. (In German). INIS.

Available from the library of the Bonn Univ.

A source of polarized protons and deuterons for the Bonn Isochronous Cyclotron has been set-up and thoroughly tested. The polarized ion beam has the following properties: Ion current strength of the polarized proton beam: 6.5 μA; of the polarized deuteron beam: 8 μA; time stability of the ion current: in the order of magnitude of 10^{-2}/h; polarization of the proton beam: P approximately ± 0.65; vector polarization of the deuteron beam: P_z approximately ± 0.55; tensor polarization of the deuteron beam: P_{zz} approximately ± 0.8; ion energy between about 2 and 8 keV continuously variable; diffusion of the ion energy in the region from 50 to 200 eV (independent of the ion energy); atomic beam intensity at the place of ionization: $>10^{18}$ sec cm^2 at a time stability $<10^{-3}$/h. The high-frequency transitions of the Bonn source are induced with transition probabilities P approximately 0.98. It is planned to increase the ion current strength of the source before connecting to the Bonn Isochronous Cyclotron. (auth)

23471 TESTING OF AN INJECTOR WITH A FIELD-EMISSION CATHODE ON AN ACCELERATOR. Voronkov, R. M.; Gass, V. F.; Danilichev, V. A.; Smirnov, I. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 944-947(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 18-20(1974).

The experimental characteristics of a linear accelerator are presented whose injector consists of a field-emission microwave electron gun. A comparison is made with characteristics obtained on the same accelerating section with an injector in the form of a Pierce thermionic gun having an energy of 120 keV. (auth)

Ion Optics and Field Calculations

Refer also to abstract 23479.

23472 TRANSVERSE SINGLE-PARTICLE INSTABILITY IN THE NAL 500 GeV ACCELERATOR. Stiening, R.; Wilson, E. J. N. (National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Instrum. Methods; 121: No. 2, 275-281(15 Oct 1974).

Experiments reveal that single-particle resonances, driven by field imperfections, limit the 8 GeV acceptance of the NAL main accelerator to protons with betatron oscillation amplitudes less than 8 mm. It is observed that resonances driven by random azimuthal field fluctuations are much weaker than those driven by average field errors acting in concert with the super-periodicity of the accelerator. This consideration dictates the choice of operating tune. Correction magnets are installed to compensate zero harmonic skew quadrupole, sextupole, and octupole errors. Separate control of dv_x/dp, dv_y/dp, d^2v_x/dp^2, and d^2v_y/dp^2 is possible in an energy-dependent manner. High azimuthal harmonic patterns of correction magnets are used to eliminate dipole, quadrupole, sextupole, and skew sextupole resonances adjacent to the operating point. A description of these systems and the improvements obtained are given. (auth)

23473 TRANSVERSE COLLECTIVE INSTABILITY IN THE NAL 500 GeV ACCELERATOR. Stiening, R.; Wilson, E. J. N. (National Accelerator Lab., Batavia, Ill. (USA)). Nucl. Instrum. Methods; 121: No. 2, 283-285(15 Oct 1974).

Vertical collective beam instability occurs during 8 GeV injection into the NAL main accelerator with an intensity threshold of approximately 10^{12} protons and a tune spread of 0.01. Horizontal collective instability has been observed at 5×10^{12} protons with a 0.01 tune spread. Sextupole, octupole, and active feedback damping have been used to control these instabilities. A brief description of these methods and the results obtained is given. (auth)

23474 TRANSVERSE TWO-STREAM INSTABILITY IN THE PRESENCE OF STRONG SPECIES-SPECIES AND IMAGE FORCES. Laslett, L. J.; Sessler, A. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Moehl, D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 121: No. 3, 517-524(1 Nov 1974).

The theory of coherent transverse oscillations of two particle species is extended to include strong species-species and image forces. It is shown that in general the species-species force can considerably alter the instability threshold. Conversely, it is shown that the limit on the performance of an electron ring accelerator imposed by the requirement of stable ion-electron oscillations is not significantly improved by the inclusion of images. (auth)

23475 ANGULAR ABERRATION CORRECTOR IN A CYLINDRICAL MIRROR ANALYZER. Zashkavara, V. V.; Tarasov, V. F. (Nuclear Physics Inst., Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 841-842(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1134-1137(June 1974).

A calculation is given for correction of third- and fourth-order angular aberrations in a cylindrical-mirror electrostatic analyzer. The correction is based on the refracting property of the potential of a double layer produced by two axially symmetric grid electrodes placed in the focal region of a charged particle beam on the axis of the cylindrical mirror. (auth)

23476 UNIFORMLY TWISTED ELECTROSTATIC QUADRUPOLE FOR GUIDING AND IMAGING CHARGED PARTICLES. Youssef, E. S. A. I. Edmonton, Alberta; Univ. of Alberta (1973). 236p.

Thesis.

A study is made of the guiding properties of a long electrostatic quadrupole that has been uniformly twisted about its axis. Analytic solutions have been developed for particle trajectories and they show that stable orbits exist if the structure parameters are properly chosen. A confinement criterion, which sets the acceptance limits of the twisted structure, has been derived using the analytic solutions. The accuracy of the analytic solutions and the validity of the confinement criterion are examined by comparing the analytical computer trajectories with those computed by numerical integration. The acceptance limits of the twisted quadrupole structure are compared to those of the classical electrostatic quadrupole channel. Twisted electrostatic quadrupole structures of finite lengths are found to be capable of identically reproducing the injection conditions of a system of particles. Such lenses have been fabricated and their imaging properties have been tested using a beam of contact charged microparticles. The experimental results are in good agreement with the theoretical analysis. A study has also been made of the effect of bending the axis of the twisted structure, and it was found that stable orbits can exist. (auth)

23477 AMPLITUDE MODULATION OF THE ACCELERATING FIELD IN A LINEAR ACCELERATOR WITH ASYMMETRIC VARIABLE-PHASE FOCUSING. Kushin, V. V.; Mokhov, V. M. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 832(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 192(Sep 1973). This is a summary of paper No. 688/7179 with full copy held at TIC.

One can increase the capture of particles in an accelerator with asymmetric variable-phase focusing if, simultaneously with periodic variation longitudinally of the synchronous phase of the accelerator ($\varphi_s = \varphi_0 \pm \varphi_1$), one also varies the amplitude of the accelerating waves [$E_m = E_0(1 \pm \epsilon)$]. The transverse and longitudinal (phase) oscillations of a particle in the dimensionless coordinates ρ, $\sigma \sim \Delta\varphi$, z are described by equations. (WHK)

23478 FEATURES OF THE INTERACTION OF AN ACCELERATED BEAM WITH THE INTERNAL TARGETS OF A PROTON SYNCHROTRON. Nikolaev, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 959-962(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 29-31(1974).

A feature of the radial-phase motion of a bunch of particles interacting with the internal target of a proton synchrotron has been considered. It is shown that the instability of beam motion revealed in the accelerator of the Institute of Theoretical and Experimental Physics is related to the operation of the automatic frequency control system of the accelerating rf field "via the beam." (auth)

Storage Rings

23479 (CERN-Trans-75-2) SET-UP FOR ELECTRON COOLING EXPERIMENTS. Anashin, V. V.; Budker, G. I.; Dikanskii, N. S. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). Jan 1975. Translation by B. Hodge of IYAF-74-86. 11p. Dep. NTIS (US Sales Only) $4.00.

The NAP-M 150-MeV proton storage ring for studying electron cooling is described. (WHK)

23480 (RL-74-100) PROPOSAL TO BUILD A 14 GeV ELECTRON–POSITRON COLLIDING BEAM FACILITY: EPIC. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 179p. Dep. NTIS (US Sales Only) $12.00.

A proposal for the construction at the Rutherford Laboratory of a 14-GeV electron-positron colliding beam facility, EPIC, is presented. The introduction gives the background to the proposal. The physics case for such a facility is outlined; a description of the basic design of the machine is presented; details of the equipment are discussed; and a list of the parameters is given. Estimates of the resources required to build the facility are included, and some of the possibilities for future development are described. (WHK)

23481 (SLAC-Trans-166) PROPOSED 1-GeV STORAGE RING FOR GENERATING SYNCHROTRON RADIATION. Kapitsa, S. P.; Duganskii, L. B.; Zykin, L. M. Dec 1974. Translation of pp 82-84 from Proceedings of the 3rd All-Union Conference on Charged-Particle Accelerators. (CONF-721028-8). 4p. Dep. NTIS $4.00.

From 3rd all-union national conference on particle accelerators; Moscow, USSR (2 Oct 1972).

The development of an electron storage ring specifically as a source of synchrotron radiation at the Institute for Physical Problems of the Academy of Sciences of the USSR is described. The source will be based on a 1.25 GeV electron storage ring. The design parameters are given. (WHK)

23482 ASSOCIATED PARTICLE SYSTEM FOR EVALUATION OF 15 MeV NEUTRON BEAM SHIELD AND COLLIMATOR DESIGNS. Jones, K. M.; Cytacki, E. P.; Kelsey, C. A. (Univ. of Wisconsin, Madison). Phys. Med. Biol.; 20: No. 1, 131-135(Jan 1975).

In fast neutron radiotherapy it is usually difficult to determine the fraction of neutrons scattered into the primary treatment field and into the penumbra by the collimator. A system utilizing the "associated particle" technique with the $^3H(d,n)^4He$ reaction and a low output neutron generator has therefore been developed for use in the evaluation of collimator and shielding designs, and patient scatter measurements. Signals from a solid state alpha detector and a neutron detector were processed, giving both n-γ discrimination and n-α coincidence, so that either proton recoil pulse height spectra or neutron time-of-flight spectra could be recorded on a multi-channel analyzer. Results are presented for a scan across the associated particle neutron beam. (UK)

23483 ION INDUCED GAS DESORPTION PROBLEMS IN THE ISR. Calder, R. S. (European Organization for Nuclear Research, Geneva). Vacuum; 24: No. 10, 437-443(Oct 1974).

Not least among the many stringent contions which must be satisfied to achieve the proper operation of the Intersecting Storage Rings at CERN are those pertaining to its 2 km of ultra-high vacuum. Apart from the direct influence of the residual gas molecules through nuclear and Coulomb scattering on the stored beam lifetimes there are also indirect processes which additionally involve adsorption/desorption phenomena on the vacuum chamber wall. The beam of high energy protons creates low energy secondary ions in the residual gas. These ions, generated in the space charge potential of 1 kV $(10\ A)^{-1}$ of proton beam, are accelerated by this potential onto the stainless steel vacuum chamber wall where a variety of adsorption/desorption phenomena may be stimulated. Desorbed molecules are fed back into the residual gas resulting in the possibility of creating an unstable runaway pressure increase which can finally destroy the stored beam. This danger depends on the local parameters of the vacuum system, and most critically, on the state of the vacuum chamber surface. The paper summarises recent observations in this field and describes the results of investigations aimed at producing cleaner surfaces in vacuum chambers. These investigations, which have included high temperature bakeouts, ion bombardment scrubbing by glow discharge, oxidation, etc, will show that under favourable conditions, net negative desorption coefficients can be obtained which turn the Intersecting Storage Rings into a large ion pump. Results, supported and compared with measurements using Auger and Sims surface analysis, are presented mainly from the empirical point of view with the emphasis on practical implications for machines where the surfaces of the vacuum system are subjected to ion bombardment. (auth)

23484 CRYOSORPTION PUMPING FOR INTERSECTING STORAGE RINGS. Halama, H.J.; Aggus, J.R. (Brookhaven National Laboratory, Upton, New York 11973). J. Vac. Sci. Technol. 12: No. 1, 532-535 (Jan 1975).

The pumps selected for storage ring vacuum systems must efficiently pump helium and hydrogen at pressures below 10^{-10} Torr. In addition, they have to work in a background of nuclear radiation. The presence of an ample supply of liquid helium in the proposed Intersecting Storage Accelerator (ISABELLE) makes cryosorption pumping very attractive. We have investigated, therefore, the behavior of Linde Type 5A molecular sieve, bonded to a stainless steel panel, at 4.2 and 5 K in the pressure range from 10^{-11} to 10^{-8} Torr. By fitting our experimental data, we obtained the constants K and B in the equation $\theta = K \exp(-\epsilon^2 B)$ which can be used to calculate the adsorption isotherms for helium and hydrogen on bonded molecular sieve 5A at various temperatures. Furthermore, we have determined the causes of a steeper slope of the isotherms in the 10^{-11} Torr range. Finally, a pump containing a cryosorption panel was exposed to a flux of 1.7×10^9 protons and pions per second which resulted in no pressure change. Based on the reults of this investigation, we have designed a cryosorption pump which can be operated at 4.2 K either inside or outside the superconducting magnet dewars. (auth)

Experimental Facilities

Refer also to abstracts 22690, 22740, 22765, 23481, and 24196.

23485 (COO-3522-3, pp 4-12) PHYSICAL PROPERTIES OF THE MSKCC CYCLOTRON PRODUCED FAST NEUTRON FIELDS. Canada, T. R.; McDonald, J. C.; Mittleman, A.; Laughlin, J. S. 1973.

In Biological and clinical dosimetry.

Detailed studies have been made of the collimated neutron fields produced in the $^9Be(d,n)^{10}B$ and the $^9Be(^3He,n)^{11}C$ reactions, using the 8 MeV deuteron and 25 MeV ^3He beams obtained from the MSKCC isochronous cyclotron. The properties which have been studied include the angular distribution of the total dose, the attenuation properties of various materials and the depth dose behavior of the total dose, the gamma ray dose, and the neutron fluence. Isodose distributions have been obtained and used to calculate preliminary treatment plans. Distributions of the dose in LET have been obtained at a number of points within the fields and used in the interpretation of some radiobiological studies. (auth)

23486 (JINR-8-7413) HELIUM TARGET. Borzunov, Yu. T.; Bolovanov, L. B.; Tsvinev, A. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). INIS.

A description is given of the construction of a helium target, and details of target operation are presented. A method of extinguishing thermoacoustic oscillations is described. Length of the working volume of the target filled with liquid helium is 120 mm. Window diameter is 80 mm. Helium evaporation rate from the target is 0.75 liters of liquid per hr. The target was fabricated in the OIYaI laboratory. (tr-SJR)

23487 (JINR-10-7197) COMMUNICATION ALGORITHM FOR OUTER DEVICES OF YRA-1001 COMPUTER ON SYNCHROPHASOTRON OF LABORATORY OF HIGH ENERGY. Khoshenko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 10p. (In Russian). INIS.

This study considers exchange algorithms with a standard selection of external devices (teletape, fast perforator, photocounter). (tr-SJR)

23488 (NP-20296) MAGNETIC ANALYZER FOR THE ENERGETIC SPECTRUM OF THE HIGH-CURRENT RELATIVISTIC ELECTRON BEAM. Gosteva, T. S.; Zablotskaya, G. R.; Ivanov, B. A.; Kolyubakin, S. N.; Chernobrovin, V. I.; Shapiro, V. B. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

The development results of the magnetic analyzer, designed for investigation of the energy spectrum of the intense electron flow in the energy range 0.2 to 3 MeV at the REP-5 accelerator are presented. (auth)

23489 PRECISION TIME-OF-FLIGHT SYSTEM FOR MEASUREMENT OF THE BEAM ENERGY OF THE MUNICH TANDEM ACCELERATOR. Huenges, E.; Vonach, H.; Labetzki, J. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Nucl. Instrum. Methods; 121: No. 2, 307-320(15 Oct 1974).

A time-of-flight system for measuring accelerator beam energies within time intervals of about 10 ms with an absolute accuracy of 1.5×10^5 has been developed and successfully put into operation.

The system improves the accuracy obtainable in the measurement of nuclear reaction Q-values, resonance and threshold energies by about an order of magnitude in many cases. In addition it can be used to correct any experimental data for Tandem energy fluctuations slower than 100 Hz. In this way the effective energy resolution of the beam analyzing system is improved to about 0.5 keV which is sufficient for the demands of the high resolution Q3D-magnet spectrograph. (auth)

23490 A VELOCITY SEPARATOR FOR HEAVY IONS USING RADIOFREQUENCY DEFLECTION. Kankeleit, E.; Krueger, F. R.; Persson, B. I. (Technische Univ. Darmstadt (F.R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 121: No. 2, 321-332(15 Oct 1974).

A new type of particle separator is proposed. It is intended primarily to separate heavy compound nuclei produced in fusion reactions from the intense background of heavy projectiles, but it should also be useful for separation of any rare reaction product from the beam background. Separation with respect to velocity as well as time of travel is accomplished by using two radiofrequency deflectors operated synchronously with the heavy ion accelerator Unilac. A practical system is investigated in some detail, and a new type of resonator providing a maximum deflection voltage of 600 kV over 6 cm at 27 MHz is described. (auth)

23491 TRANSVERSE FOCUSING FOR A BROAD-RANGE SPECTROGRAPH. Gross, E. E. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 121: No. 2, 297-299 (15 Oct 1974).

To enhance the solid angle of the broad-range spectrograph, a transverse-focusing quadrupole-singlet has been added to the system. Depending on position along the focal plane, a gain in solid angle of a factor of 6 to 10 has been realized. Other properties of the new system are presented. (auth)

23492 THE MEASUREMENT OF SUBNANOSECOND LIFETIMES USING A ROTATING TARGET SYSTEM. White, D. C. S.; McDonald, W. J.; Neilson, G. C.; Hutcheon, D. A. (Alberta Univ., Edmonton (Canada). Nuclear Research Centre). Nucl. Instrum. Methods; 121: No. 3, 439-443(1 Nov 1974).

A rotating target system has been developed for use in the measurement of lifetimes of excited nuclear states by a direct timing technique using a pulsed proton or deuteron beam. The target system which is capable of speeds up to 7000 r.p.m. can be used with two targets simultaneously. The system has the electronics capable of routing into two separate regions of the on-line computer the information obtained from each target. The technique has a distinct advantage over most previous centroid shift delayed-coincidence methods in that data are obtained at the same time for both the prompt and delayed time distribution curves. Thus errors that may occur due to electronic drifts and shifts between alternate experimental runs to obtain the prompt and delayed time distribution curves separately are avoided. As an illustration of the use of the rotating target system, the lifetime of the first excited state of ^{47}Ti at 160 keV was measured to be (295 ± 24) ps. (auth)

23493 PREPARATION OF POWDERED TARGETS. Ku, T. H.; Karol, P. J. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). Nucl. Instrum. Methods; 121: No. 3, 537-540(1 Nov 1974).

Routinely successful preparation of sturdy powder targets with uniform thicknesses ranging from 1 to 20 mg/cm^2 by a conveniently simple technique is discussed. Targets produced are sandwiched between and aligned with Al foils by the procedure. Quality of the targets is verified with scanning electron microscopy and beta radiography. The technique should be applicable to a wide variety of materials. (auth)

23494 THE VICKSI BEAM HANDLING SYSTEM. Hinterberger, F. (Bonn Univ. (F.R. Germany). Inst. fuer Strahlen- und Kernphysik); Efken, B.; Hinderer, G.; Maier, K. H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany)). Nucl. Instrum. Methods; 121: No. 3, 525-532(1 Nov 1974).

The VICKSI beam handling system is designed for experiments with pulsed heavy ion beams. It provides nine target areas. Six target areas are reached after the passage of two 90°-bending magnets. The following beam preparation modes are possible: (1) double dispersive, double telescopic, vanishing angle dispersion, energy resolution up to 8000; (2) nondispersive, off-midplane telescopic, adjustable time-energy coefficient, variable energy resolution up to 4000, variable time-of-flight resolution below 1 ns; (3) achromatic, off-midplane telescopic, on-midplane nearly telescopic, variable energy resolution up to 4000. (auth)

23495 FAST NEUTRONS PRODUCED BY BOMBARDING A BERYLLIUM TARGET WITH 40 MeV HELIUM-3 IONS. Parnell, C. J.; Page, B. C.; Jones, E. J. (Hammersmith Hospital, London). Phys. Med. Biol.; 20: No. 1, 125-127(Jan 1975).

Isochronous cyclotrons are capable of accelerating ^{3}He ions to an energy about 2.7 times that of deuterons, that is, 40 MeV ^{3}He ions from a machine giving 15 MeV deuterons. Measurements were made with the neutron beam produced by bombardment of a beryllium target with these 40 MeV ^{3}He ions, in order to investigate the potentialities of the system for the production of fast neutron beams in radiotherapy. A comparison was made of the depth dose curves in a water phantom for neutrons produced by bombarding a 150 mg cm^{-2} beryllium target with either 40 MeV ^{3}He ions, or 16.7 MeV deuterons. For a 12 × 12 cm field at 125 cm target-skin distance the neutron dose decreased to 50% at 9.6 cm when 40 MeV ^{3}He ions were used. This was about 0.6 cm greater than the value obtained with 16.7 MeV deuterons. A limiting factor in the practical application may be the low neutron dose rate at 125 cm (14.7 rad min^{-1} for an incident ^{3}He ion current of 100 μA). However, if a target thicker than the range of incident ^{3}He ions is used the dose rates should be slightly higher and the depth doses slightly lower than these values. (UK)

23496 NEUTRON GENERATOR TARGET ASSEMBLY. Cranberg, L. (to Lawrence Cranberg). US Patent 3,860,827. 14 Jan 1975. Filed date 5 Sep 1972. 10p.

A neutron generator target assembly including a neutron-emissive target material disposed on a target supporting structure having a conic target supporting surface and a cooling surface in thermal contact with the target supporting surface is described. Means are provided for flowing a cooling fluid over the cooling surface to dissipate the energy imparted to the target when the target is bombarded by a high intensity ion beam. (Official Gazette)

23497 PULSED NEUTRON SOURCE. Vasiliev, A. A.; Meshcherov, R. A.; Murin, B. P.; Stavisskii, I. Y. US Patent 3,860,828. 14 Jan 1975. Priority date 10 May 1972, USSR. 8p.

A pulsed neutron source is disclosed comprising a high-current negative hydrogen ion H$^-$ accelerator which shapes and accelerates H$^-$ bunches having a preset duration and repetition interval to the energy of 0.4 to 1 GeV, and a bunching storage ring for proton bunches furnished with a charge-exchange injecting system and with an extraction system for ejecting the proton bunches onto an external neutron-producing target, the bunching storage ring for proton bunches being designed so that the revolution period of proton bunches on the orbit thereof is equal to or is a multiple of the repetition interval of H$^-$ bunches shaped in the accelerator. (Official Gazette)

23498 SPECIALIZED ACCELERATORS: HIGH INTENSITY MESON FACILITIES. Livingston, M. S. (Los Alamos Meson Physics Facility, NM). pp 113-127 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Requirements and accelerators for meson production are discussed; and three medium intensity meson production facilities under construction (Tri-University Meson Facility, Swiss Institute for Nuclear Research, and the Nevis Cyclotron at Columbia University) are described. Also, the Los Alamos Meson Physics Facility which is the largest, high-energy and high-intensity meson production facility at present is described. (WHK)

23499 POLARIZATION EXPERIMENTS: POLARIZED TARGETS. Catillon, P. (CEN de Saclay, Gif-Sur-Yvette, France). pp 193-212 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

The general principles of polarized targets are given, and some typical experiments using these techniques are described. The polarization techniques include static methods of thermal equilibrium, dynamic methods, and optical pumping. Also, cryogenics for polarized targets is discussed. (WHK)

23500 TECHNIQUES FOR THE STUDY OF SHORT-LIVED NUCLEI. Macfarlane, R. D. (Texas A and M Univ., College Station); McHarris, W. C. pp 243-286 of Nuclear Spectroscopy and Reactions. Part A. Cerny, J. (ed.). New York; Academic Press, Inc. (1974).

Techniques for studying short-lived nuclei including rabbit systems, gas transport systems, accelerator pulsing techniques, fast radiochemical techniques, and current and novel approaches including the RAMA system at Orsay and the electrostatic particle guide and MAGGIE recoil time-of-flight system at Texas A and M University are discussed. (WHK)

23501 DESIGN OF PION AND MUON CHANNELS. Al-Qazzaz, N. M. M. Victoria, B. C.; Univ. of Victoria (1973). - 307p. Thesis.

Various concepts for the transportation of pions and muons from

production targets external to the TRIUMF accelerator have been studied. A dual purpose magnetic channel capable of providing a pion beam and a muon beam has been designed. Phase One of the system consists of five quadrupoles and two bending magnets, and forms the pion collection section of the muon channel. It also serves as a stopped pion channel. The maximum solid angle of acceptance of this channel is 26 msr and the range of accepted momenta extends 17.5% on each side of the central momentum. Phase Two of the design consists of a long straight alternating gradient section and an analyzing section. The straight section provides an extra 5.5 meter length for pion decay. (CA)

23502 TRITIUM TARGET FOR NEUTRON SOURCE. Ormrod, J. H. (to Atomic Energy of Canada, Ltd.). Canadian Patent 957,086. 29 Oct 1974.

A tritium target for a neutron source is described that comprises a target layer of tritiated titanium sandwiched between layers of aluminum oxide which act to inhibit diffusion of titanium out of the target layer, a layer of aluminum on the front or beam side of said target to act as a sputter shield, a metallic backing layer behind the target, and cooling means adjacent the backing layer for cooling the said target and absorbing and diffusing stopped deuterons. (auth)

23503 X-RAY DEPTH DOSES FROM LINEAR ACCELERATORS IN THE ENERGY RANGE FROM 10 TO 32 MeV. Podgorsak, E. B.; Rawlinson, J. A.; Johns, H. E. (Ontario Cancer Inst., Toronto). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 123: No. 1, 182-191(Jan 1975).

The depth dose characteristics of the x-ray beam from a linear accelerator have been studied in the electron energy range from 10 to 32 MeV for various target and flattening filter combinations. At all energies the most penetrating x-ray beam is obtained with a low atomic number flattening filter. At energies below 15 MeV a high atomic number target should be used, while at energies above 15 MeV a low atomic number target should be employed to get the best depth dose distribution. The optimum target thickness is approximately equal to the mean range of electrons in the target material. The study of some physical parameters, such as depth dose, average dose, and integral dose, suggests that the optimum energy for linear accelerators used in the x-ray mode is about 25 MeV. (auth)

23504 TRITIUM DEPTH PROFILING BY NEUTRON TIME-OF-FLIGHT. Davis, J.C.; Anderson, J.D. (Lawrence Livermore Laboratory, Livermore, California 94550). J. Vac. Sci. Technol. 12: No. 1, 358-360 (Jan 1975).

A method has been developed to measure the depth profile of tritium implanted or absorbed in materials. The sample is bombarded with a pulsed proton beam. Neutron energies from T (p,n) reactions occurring in the target are measured by time-of-flight over a 10.8-m flight path. From the neutron energy the proton energy and, thus, the tritium depth in the target may be inferred. The measurements were initiated to determine the depletion of tritium absorbed in titanium layers. These layers had served as targets on a 400-keV T (d,n) neutron generator. A depth resolution of 0.4 mg/cm^2 of titanium (0.9 μ) was obtained. Unlike proton backscattering methods, the technique can be used with thick samples. We estimate that a sensitivity of 0.1 at.% tritium in host materials can be obtained. Extension of the method to deuterium depth profiling is possible with the use of the D (d,n) reaction. (auth)

23505 HELIUM TARGET. Borzunov, Yu. T.; Golovanov, L. B.; Tsvinev, A. P. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 963-966(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 32-34(1974).

The construction of a helium target with an internal cold scintillator for studying elastic scattering of pions by helium nuclei is described; the features of target operation with an intermediate vessel are presented, and a method for quenching thermal acoustic oscillations is described. (auth)

23506 CHAMBER FOR STUDYING CHANNELING AND SHADOW EFFECTS. Zlobin, V. G.; Kolyada, V. M.; Legkov, B. E. (Inst. of Analytic Instrument Design, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 967-968(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 35-36(1974).

A chamber for studying channeling and shadow effects which develop as a result of the interaction of fast charged particles with single crystals is described. The investigated sample is attached to a goniometric head having three degrees of freedom and allowing the sample to be heated up to 500°C. The scattered particles are recorded by means of photographic plates having the dimensions 6 × 9 mm, which are placed into a cassette mechanism. (auth)

23507 SYNCHROTRON RADIATION PATH FOR VACUUM ULTRAVIOLET SPECTROSCOPY. Didenko, A. N.; Kozhevnikov, A. V.; Nikitin, M. M.; Timchenko, N. A. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 948-950(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 20-22(1974).

The path for extraction of synchrotron radiation from the "Sirius" accelerator is described; this path is designed for spectroscopy in the vacuum ultraviolet range. The spectral and angular responses of the synchrotron radiation are presented; the intensity of the radiation is estimated in the plane of the input slit of the vacuum monochromator at a distance of 10 m from the radiation point. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

23508 RESEARCH PROGRAMS FOR THE NEW LARGE TELESCOPES. Proceedings of the Third Conference Held at Geneva, Switzerland, May 27–31, 1974. Reiz, A. (ed.). Geneva; European Southern Observatory (1974). 411p.

Research possibilities and priorities for the new large telescopes in the 3.5 to 4.0 m range which are scheduled to begin operation in the next decade are discussed, and key subjects in optical astronomy are reported and reviewed. The topics include a description of current activities at the Hale, Lick, and Kitt Peak observatories; use of large optical telescopes in the infrared; research on southern globular clusters, the center of the galaxy, nearby galaxies, and quasars; desiderata from theoretical work on interstellar matter, the chemical evolution of galaxies, stars and stellar evolution, and dense objects; research on the Magellanic clouds; observational cosmology of distant galaxies, complete samples of 3CR and 4C quasars, reports of the Westerbork program and the results of the Parkes 2700 MHz survey, and statistical studies of QSOs; instrumental capabilities, developments in photographic emulsions and sensitizing techniques, photographic recording, Schmidt telescopes, measurement and analysis of images; and considerations about the philosophy of telescope use, including scheduling, time allocation, and organization. (IAA)

23509 FUNDAMENTAL ASTRONOMY: SOLAR SYSTEM AND BEYOND. Cole, F. W. New York; John Wiley and Sons, Inc. (1974). 480p. $10.95.

An introduction to the field of astronomy is provided which is especially useful to the nonscientist. The fundamental concepts in the study of the solar system and the stars are explained. The study of the moon incorporates data obtained in the Apollo missions. Also discussed are stellar evolution, the structure of the Universe as a whole, and various cosmological models. An appendix includes a guide to beginning observational astronomy using a small telescope. (IAA)

Cosmic Radiation

Refer also to abstracts 22695, 23792, and 23974.

23510 MEASUREMENTS OF COSMIC RAY HEAVY NUCLEI AT SUPERSONIC TRANSPORT ALTITUDES AND THEIR DOSIMETRIC SIGNIFICANCE. Allkofer, O. C.; Heinrich, W. (Univ., Kiel). Health Phys.; 27: No. 6, 543-551(Dec 1974).

A review is presented of cosmic-ray data with special regard to heavy nuclei, the interactions of heavy nuclei with matter and the radiobiological significance of low-energy nuclei. The flux of the heavy nuclei in the upper atmosphere was measured by balloon-borne plastic stacks which were flown several times at 40 g cm^{-2} residual atmosphere for a total time of 25 hr. From these measurements and from theoretical investigations the probabilities for hits of stopping nuclei per cm^3 of tissue for SST-flights at different altitudes are derived. (auth)

23511 COSMIC-RAY ELECTRON AND POSITRON SPECTRA AND THEIR MODULATION. Cecchini, S. (CNR, Bologna); Winkler, C. Lett. Nuovo Cim.; 12: No. 3, 86-90(18 Jan 1975).

A study of the modulation of the electron and positron cosmic-ray component is presented. It is emphasized that similar constraints exist in the choice both of the diffusion coefficient and of the shape of the galactic electron spectrum for low energy electrons (below 200 MeV), as can be learned from a comparison between the calculated and observed positron spectrum below 200 MeV. (JFP)

23512 NEW TECHNIQUE FOR THE ESTIMATION OF THE FAST COSMIC RAY FLUX FROM THE MEASUREMENT OF THE $^{146}Sm/^{147}Sm$ RATIO. Le Roulley, J. C.; Yokoyama, Y.; Lambert, G. (CNRS, Gif-sur-Yvette, France). Compt. Rend., Ser. B; 278: No. 19, 869-872(6 May 1974). (In French).

It is shown that the direct measurement of the relative abundance of the radioisotopes ^{146}Sm and ^{147}Sm on the Moon's surface or on meteorites with α spectrometry, should make it possible to evaluate the average intensity of the cosmic radiation during the past 10^8 years. (FR)

23513 OUTBURSTS OF COSMIC GAMMA RAYS. Montmerle, T. Recherche (Paris); 5: No. 47, 666-668(Jul 1974). (In French).

Since they were launched in July 1960 the satellites of the Vela series have detected signals in the gamma band of the electromagnetic spectrum (0.2 to 1.5 MeV). The signals, lasting a few seconds, are emitted at the rate of about five per year at the sensitivity level of the apparatus and are certainly of extraterrestrial origin. Various methods have been proposed to interpret these phenomena. (FR)

23514 NUCLEAR EMULSION DOSIMETRY OF HEAVY COSMIC RADIATION IONS DURING APOLLO FLIGHTS. Pfohl, R.; Kaiser, R. (CNRS, Strasbourg). Radioprotection; 9: No. 1, 1-6 (1974). (In French).

During the flight of Apollo XVI, the dosimetry of heavy ions was effected with nuclear emulsions present in the Biostack. The charged particles passing through an emulsion leave a trace which after development is characteristic of the incident particle and of its energy. A method is described for determining the transfer of linear energy of particles based on opacity and particle size determinations. The results obtained during the Apollo XVI and XVII flights are given in detail. (FR)

23515 THE ORIGIN OF THE COSMIC GAMMA-RAY BURSTS. Sofia, S.; Van Horn, H.M. (Joint Institute for Laboratory Astrophysics, University of Colorado and National Bureau of Standards). Astrophys. J. 194: No. 3, 593-595 (15 Dec 1974).

We suggest that cosmic γ-ray bursts may be produced by collisions of chunks of antimatter of mass $\sim 10^{15}$ g with normal stars. If the total mass fraction of such chunks in the Galaxy is $\sim 10^{-6}$, this model appears capable of accounting for the observed characteristic energy of the spectrum, total energy, duration, and frequency of occurrence of the bursts. Some observational tests are suggested to check the validity of this hypothesis. (auth)

23516 PITCH-ANGLE SCATTERING OF CHARGED PARTICLES IN A RANDOM MAGNETIC FIELD. Jokipii, J.R. (Departments of Planetary Sciences and Astronomy, University of Arizona). Astrophys. J. 194: No. 2, 465-469 (1 Dec 1974).

Pitch-angle scattering of low-rigidity particles in a random magnetic field is considered keeping terms to first order in $\langle B_1^2\rangle/B_0^2$, where B_1 is the (transverse) fluctuating magnetic field and B_0 the average field. If one works in terms of the local pitch-angle cosine $\mu = \langle \mathbf{w}\cdot\mathbf{B}\rangle/wB$ (rather than the average $\mu_A = \mathbf{w}\cdot\mathbf{B}_0/wB_0$), one finds that (a) the Fokker-Planck coefficients are given by the usual resonant expression at all angles and (b) the correlation scale of the magnetic fluctuations does not enter directly into the approximation. Corrrections to resonant scattering must come from terms of higher order in $\langle B_1^2\rangle/B_0^2$. (auth)

23517 GALACTIC CONTRIBUTIONS TO THE ISOTROPY OF THE COSMIC X-RAY BACKGROUND. Fabian, A. C. (University Coll., London). Astron. Astrophys.; 32: No. 2, 127-131(May 1974).

Observations of the cosmic x-ray background in the energy ranges of 1 to 3 keV and 3 to 9 keV were analyzed for fluctuations. A positive fluctuation in the 1 to 3 keV samples was interpreted in terms of a galactic contribution. Although such a contribution is small in intensity terms, it will produce a relatively large measure of fluctuations. The galactic distribution of these sources is discussed, and it is deduced that they are unlikely to give rise to many of the weak high latitude x-ray sources unless they have a scale height $\langle z\rangle$, greater than 600 pc. (auth)

23518 GAMMA-RAY BURSTS OBSERVED BY A HARD X-RAY EXPERIMENT ABOARD OSO-6. Pizzichini, G.; Palumbo, G.G.C.; Spizzichino, A. (Laboratorio di Tecnologie e Studio delle Radiazioni Extraterrestri, Consiglio Nazionale delle Ricerche, Bologna, Italy). Astrophys. J. Lett. 195: No. 1, L1-L5 (1 Jan 1975).

The data of the Bologna hard X-ray experiment aboard the OSO-6 satellite have been searched for events in coincidence with the 14 cosmic γ-ray bursts by Strong, Klebesadel, and Olson which occurred during the OSO-6 lifetime (1969 August to 1972 January). Three events have been detected. The first one (69-2) was discussed in a previous paper. We report here on the other two events (71-6 and 71-3) and give the information that could be deduced from our data about the remaining 11 Vela events which were not detected. For some of these events it has been possible to exclude one of the Vela positions. (auth)

23519 BOUNDS ON NEUTRINO BURST INTENSITY IMPOSED BY THE EXCLUSION PRINCIPLE AND CAUSALITY. Bludman, S.A. (Department of Physics, University of Pennsylvania); Ruderman, M.A. Astrophys. J. Lett. 195: No. 1, L19-L21 (1 Jan 1975).

Two different limits on the antineutrino (or neutrino) luminosity of a source are derived respectively from the exclusion principle and from the strength and form of weak interactions. Together with causality, the statisitics of burst observations, and the maximum total mass in local astronomical objects, our exclusion principle limit on luminosity rules out nearby or nonrelativistic sources as astrophysical models for recently

reported antineutrino bursts. More distant sources with relativistically expanding shells are ruled out by our weak interaction limit. (auth)

Stars

Refer also to abstracts 23640, 23731, 23732, 23752, 24199, 24200, 24207, 24208, 24217, 24568, 24569, and 24573.

23520 VSPYKHIVAIUSHCHIE ZVEZDY. (Flare Stars). Gurzadyan, G. A. Moscow; Izdatel'stvo Nauka (1973). 368p.

The monograph provides a systematic review of observational data and theoretical interpretations about star flares. A star flare theory is developed on the basis of a corpuscular concept of the nature of star flares. Analyses are presented for such fundamental dynamic parameters as the brightness increase amplitude, color indices, emission line excitation, and brightness curve characteristics. Individual chapters are devoted to Taurus-T-type stars, flare stars in stellar associations, as well as flare-star radio emission. Probability forecasts for x-ray radiation during flares are discussed. Special attention is given to a theory of radiation energy transfer through a relativistic electron medium, allowing for the reverse Compton effect. Cosmogony and evolution problems pertaining to flare stars are also considered. (IAA)

23521 CHEMICAL COMPOSITIONS OF COOL HELIUM AND CARBON WHITE DWARFS. Grenfell, T. C. (Univ. of Washington, Seattle). Astron. Astrophys.; 31: No. 3, 303-315(Mar 1974).

An atmospheric abundance analysis is carried out for the white dwarfs vMa 2 (DG), G 47-18 (λ4670), and G 99-37 (λ4670). Spectroscopic observations of Oke and Shipman to calibrate the spectral data are combined with nongray model atmospheres including convection. A spectrum synthesis is performed over the entire wavelength range where spectral features are observed in order to avoid an arbitrary choice of the continuum level and to account for overlapping atomic lines and molecular bands. The derived chemical composition for vMa 2 is nearly the same as found by Wegner (1972) while $T_{eff} \cong 5800°K$ and $\log g \cong 7.42$. The two λ4670 stars are nearly pure helium, and the abundance of carbon is approximately 10^{-3} with O:C ~ 1. The ratio of metals to carbon is less than 10^{-5} for G 99-37 and probably similar for G 47-18. (auth)

23522 MODEL ATMOSPHERES FOR C TYPE STARS. Querci, F.; Querci, M.; Tsuji, T. (DEPEG Observatoire de Paris, Meudon, France). Astron. Astrophys.; 31: No. 3, 265-282(Mar 1974).

Model atmospheres with abundances that could be representative of C type stars have been calculated for effective temperatures T_e = 4500, 4200, 3800, and 3400°K and gravities g = 0.1, 1.0, and 10 cgs units. They are based on the classical hypothesis and take into account radiative and turbulent pressures. The molecular line blanketing effect by CO, CN, and C_2 is included through opacity probability distribution functions. This line opacity treatment uses the Strom and Kurucz method (1966) partly modified for the case of these cool highly blanketed atmospheres. Opacity sources include also absorption and/or scattering due to H^-, H_2, H_2^+, H, He^-, C^-, C, e^- together with some metallic absorption and the pressure-induced opacities due to H_2-H_2 and H_2-He collisions. The results are compared with other late-type star models which represent the molecular opacity by some kind of mean, and it is shown how the resulting $T(\tau)$ relations can change. The surface temperatures are clearly lower. The calculated emergent fluxes are in reasonable agreement with observation except in the visual region. (auth)

23523 EVOLUTION OF SPECTRUM OF THE NOVA HERCULIS 1963 IN THE NEBULAR PHASE. Andrillat, Y. (Universite des Sciences et Techniques, Montpellier, France); Collin-Souffrin, S. Astron. Astrophys.; 31: No. 3, 347-351(Mar 1974). (In French and English).

The equivalent widths and relative intensities of the emission lines in the spectrum of the Nova Her 63 were determined in the range 3700 to 8500 Å, from April to September 1963. (auth)

23524 ANALYSIS OF THE ENERGY DISTRIBUTION OF THE BE STAR π AQR. Nordh, H. L.; Olofsson, S. G. (Stockholm Observatory). Astron. Astrophys.; 31: No. 3, 343-345(Mar 1974).

The energy distribution of the Be star π Aqr and its variability are analyzed in the spectral region 3500 to 10400 Å. The "excess radiation" can be explained as hydrogen free-bound and free-free emission from an envelope. This explanation implies a great optical thickness in the H β emission line and also raises doubts whether the envelope is photo-ionized. The long term variability exhibits a peculiar spectral behavior, tentatively proposed as partly due to changing properties in the envelope. (auth)

23525 COMMENT ON "SELF-CONSISTENT SOLUTION FOR AN AXISYMMETRIC PULSAR MODEL." Michel, F. C. (Rice Univ., Houston, TX). Phys. Rev. Lett.; 33: No. 25, 1521-1523 (16 Dec 1974).

The numerical results of Kuo-Petravic, Petravic, and Roberts, in which magnetic field lines are found to close beyond the light cylinder, are reconciled with the canonical theoretical view that these field lines must be open. It is argued that a small region of trapped plasma on closed field lines relatively near the star (but nevertheless outside of it) expands until the light cylinder is reached. The remaining field lines are forced open and do not close beyond the light cylinder. (auth)

23526 PROBLEM OF PERIOD IN THE GRAVITATIONAL FIELD OF A ROTATING BODY. Kurmakaev, Z. Kh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 120-121(1972). (In Russian).

It is indicated that in the article by Metskevei, et al. (1962) an incorrect connection between Kerr's parameter and the angular momentum of a body was used. (auth)

23527 RELATIVISTIC TENSOR OF TENSION OF THE SOLID BODIES IN THE GENERAL RELATIVITY THEORY. Kozhanov, T. S. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 122-128 (1972). (In Russian).

Analytical expressions of the relativistic tensor of tension for three different motions of solid bodies: rectilinear, rotational, and their combination are obtained. (auth)

23528 MODEL FOR STELLAR INTERIOR; PRE-MAIN SEQUENCE EVOLUTION AND DEUTERIUM BURNING. Toma, E. (National Council for Science and Tech., Bucharest). Stud. Cercet. Fiz.; 26: No. 8, 839-868(1974). (In Rumanian).

Evolution tracks and the effect of chemical composition and mixing length ratio on tracks are calculated. Deuterium burning and consequent vibrational instability are discussed. The observation of deuterium burning in stars is considered. (WDM)

23529 ZONAL SPECTROPHOTOMETRICAL STANDARDS. Distribution of the Energy in the Spectrum of the 109 Stars in Absolute Units. Tereshenko, V. M.; Kharitonov, A. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 98-103(1972). (In Russian).

In the article an absolute distribution of energy in the spectrum of 109 stars is given. The stars can be used as photometrical standards. (auth)

23530 VARIATIONS OF H_β IN THE Be-STAR PSI PER. Sapargalieva, L. M. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 104-109(1972). (In Russian).

Changes of the form and intensity of the H_β profiles are considered. Profiles computed in rest intensities are given. Equivalent widths of the photosphere and of the shell components were measured. All the components of the line are characterized by a fairly rapid variation during one night and from night to night. A correlation between the total intensity of the emission line and the narrow shell absorption is detected. (auth)

23531 MEASUREMENTS OF VELOCITY DISPERSIONS AND DOPPLER SHIFTS FROM DIGITIZED OPTICAL SPECTRA. Simkin, S. M. (Columbia Univ., New York). Astron. Astrophys.; 31: No. 2, 129-136(Mar 1974).

Techniques are discussed for measuring Doppler shifts and velocity broadening profiles of stars and galaxies from digitized optical spectra. These assume that the spectrum under study can be described as if it were "generated" from a "prototype" star of the same mean spectral class by Doppler shifting the latter and subjecting its features to velocity broadening. The techniques are based on methods of time series analysis and rely heavily for their feasibility on application of the Fast Fourier transform algorithm. Two functions are described for measuring Doppler shifts. One of these is the cross-correlation function (c.c.f.), well known to engineers. The other is termed a "variance" function and seems to measure the same parameters as the c.c.f., providing a convenient means of checking measurements done with the latter. In addition techniques are documented that allow one to measure velocity broadening in spectra. It is pointed out that the methods described can be applied to a wide variety of problems. Among these are: measurement of stellar rotation, gas streaming motions in close binaries, stellar radial velocities, velocity dispersions of stars in galaxies, and galaxy redshifts. (auth)

23532 PULSATIONAL INSTABILITY TOWARDS NONRADIAL OSCILLATIONS IN HOMOGENEOUS STARS OF SMALL MASS. Noels, A.; Boury, A.; Scuflaire, R.; Gabriel, M. (Univ., Liege). Astron. Astrophys.; 31: No. 2, 185-188(Mar 1974).

The pulsational stability of a 0.5 $M_\odot$ star composed of a radiative core and an extended convective envelope is studied. The

star is found strongly unstable because of the high-temperature sensitivity of the He^3 reaction. This instability should affect only a very small range of masses. (auth)

23533 OBSERVATIONS OF A VARIABLE EMISSION CORE IN THE H_β LINE OF HZ HERCULIS. Barbon, R. (Univ., Padua); Benvenuti, P.; Bernacca, P. L.; Ciatti, F.; Treves, A. Astron. Astrophys.; 31: No. 2, 237-238(Mar 1974).

Spectroscopic observations of HZ Her, the optical counterpart of Her X-1, indicate the existence of variable emission in H_β, which is suggested to be associated with the formation of the disk surrounding the neutron star. The spectral behavior of H_β is not correlated with any of the periodic phenomena of the x-ray binary. (auth)

23534 INVESTIGATION OF THE WOLF–RAYET SPECTROSCOPIC BINARY HD 152770; LINE IDENTIFICATIONS AND RADIAL VELOCITIES IN THE SPECTRAL REGION 3500 TO 6000 A. Seggewiss, W. (Univ., Bonn). Astron. Astrophys.; 31: No. 2, 211-221(Mar 1974).

The spectrum of the Wolf–Rayet star HD 152270 was investigated on plates taken with the ESO coudé-spectrograph (12.3 Å/mm dispersion) and the new Cassegrain-spectrograph of Boyden Observatory (134 Å/mm dispersion). (WDM)

23535 UV EXCESS STARS AND RADIO SOURCES IN THE AQUILA RING. Isserstedt, J. (Univ., Bochum, Ger.). Astron. Astrophys.; 31: No. 2, 207-210(Mar 1974).

With MK spectral classification and photoelectric UBV photometry the uv-excess, defined by $\Delta(U-B) = (U-B) - E_{U-B} - (U-B)_0$, were determined for each star of the Aquila ring. The uv-excesses are similar to the excesses of young open clusters and show that many of the stars in the Aquila ring might be still in the pre-main-sequence stage of their evolution. The scatter of radial velocities for stars with uv-excesses is smaller than that for all stars. There are some radio sources on the ring. In addition, the ring seems to be surrounded by a shell of radio sources with a diameter of 37 pc, which might be a very old supernova remnant. (auth)

23536 SPECTROSCOPIC STUDY OF THE R CrB TYPE STAR XX CAMELOPARDALIS IN QUIET STATE. Orlov, M. Ya.; Rodriguez, M. H. (Main Astronomical Observatory, Kiev). Astron. Astrophys.; 31: No. 2, 203-206(Mar 1974).

A quantitative analysis of a R CrB type star XX Cam was performed by the curve-of-growth method using coudé-spectrograms (dispersion 8Å/mm, $\lambda\lambda$ 4000 to 5000 Å) obtained at maximum brightness. No conspicuous Balmer lines of hydrogen were found. 62 lines of carbon were identified, as well as oxygen lines with excitation potentials up to 11 eV. Equivalent widths of 360 lines were measured. Microturbulent velocity was 8.9 km/s, damping constant $a = 0.001$, electron pressure $\log p_e = -2.60$ (from Fe I and Fe II lines only). Relative abundances of Ca, Sc, Ti, V, Cr, Mn, and Y turned out to be very close to solar values. Ratio of carbon to iron is 100 times greater in the atmosphere of XX Cam than in the solar atmosphere. (auth)

23537 CORRECTNESS OF STELLAR SYSTEMS MODELS. Genkin, I. L.; Genkina, L. M. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 3-7(1972). (In Russian).

The problem of correctness of stellar systems models when integral equations of the first kind are applied is considered. Examples of the instability of solutions as regards the initial conditions are given. (auth)

23538 POSSIBLE CARBON-STAR MEMBER OF THE OLD OPEN CLUSTER TRUMPLER 5. Kalinowski, J. K.; Burkhead, M. S.; Honeycutt, R. K. (Indiana Univ., Bloomington). Astrophys. J., Lett.; 193: No. 2, L77-L80(15 Oct 1974).

A very red($B-V \approx 6.1$) object, V493 Mon, is identified as a carbon star. The possibility of its membership in the old open cluster Trumpler 5 is discussed. (auth)

23539 SPECTRUM OF VI CYGNI NO. 12 NEAR 10 MICRONS. Rieke, G. H. (Univ. of Arizona, Tucson). Astrophys. J., Lett.; 193: No. 2, L81-L82(15 Oct 1974).

Narrow-band photometry in the 10-μ region shows a "silicate" absorption feature in the spectrum of VI Cyg No. 12 at 10 μ. (auth)

23540 STABILITY OF SPHERICAL STELLAR SYSTEM. Pal'chik, M. Ya.; Patashinskii, A. Z.; Pinus, V. K. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 63-73(1974). (In Russian).

The stability of a spherically symmetrical cluster of localized gravitating particles of relatively small random perturbations was studied. It was considered that in the absence of perturbation, a particle is moved in a circular trajectory, randomly oriented in space so that the total moment of the cluster is zero. The size of the cluster is small compared to the gravitation radius and the rate of the particles is nonrelativistic. It is shown that there are initial distributions of massive density of the cluster which are unstable relative to any perturbations except for radial and dipole perturbations. The general criterion of instability is formulated as $d\Omega^2/dr > 0$, where $\Omega^2 = (4\pi G/r^3)\int_0^r \rho_0 r^2 dr$, $\rho_0(r)$ is the massive density of the cluster, and G is the gravitation constant. The dependence of the increment on the number of the harmonics of the perturbation was studied. In the case of weak heterogeneity, $r(d\Omega^2/dr)/\Omega^2 \ll 1$, the increment is maximum for quadrupole perturbation and decreases monotonically with increase in the number of the harmonics and may be rather small. With a strong heterogeneity, instability develops in a time smaller than the period of revolution of individual particles. With $(d\Omega^2/dr)/\Omega^2 < 0$ the system is stable. Calculation of the microstructures of the system in this case leads to damping of the microwaves ("heating" of the system). (tr-auth)

23541 SOME SIDEREAL PERIODS IN THE GRAVITATIONAL FIELD OF THE ROTATING BODY. Kurmakaev, Z. Kh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 9-12(1967). (In Russian).

For both the coordinate time and the proper time two periods are defined: the sidereal period of the direct circular motion and the sidereal period of the retrograde circular motion. The four periods are calculated approximately. (auth)

23542 FOURTH LIST OF THE EXTRAATMOSPHERIC SPECTROMETRIC STANDARDS. The Distribution of the Energy in the Spectra of 13 Stars in Absolute Units. Kharitonov, A. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 70-78(1966). (In Russian).

The distribution of energy in the spectra of 13 stars is given in absolute energy units. The accuracy of the results is about 9%. (auth)

23543 SPECTROPHOTOMETRY OF PECULIAR STARS. II. Glagolevskii, Yu. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 57-69(1966). (In Russian).

Magnetic and peculiar stars have anomalies in the distribution of energy in their spectra and have weak hydrogen lines. It is difficult to explain these anomalies by effective temperature, electron pressure, electron scattering, absorption by hydrogen negative ions H^-, or chemical composition. The probability of the synchrotron radiation as the source of the anomaly in the distribution of energy is discussed. (auth)

23544 INFLUENCE OF RAPID AXIAL ROTATION UPON THE CONTINUOUS SPECTRUM OF STARS. Kozlova, K. I.; Glagolevskii, Yu. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 48-56(1967). (In Russian).

Roche's model and Zeipel's theorem have been used. Parameters of the continuous spectrum (D, φ_1 and φ_2) were received for the star, which is rotating with maximum speed and can be seen from the pole. It is shown, that rapid rotation did not affect greatly the continuous spectrum of the star in the visible and close ultraviolet region of the spectrum. (auth)

23545 COMPARISON OF THE PROPERTIES OF CONTINUOUS SPECTRA OF PECULIAR AND METALLIC LINE STARS. Kozlova, K. I.; Glagolevskii, Yu. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 57-62(1967). (In Russian).

It is shown that peculiar and metallic line stars have properties, close to the ones of continuous spectra. It is shown as well that they possess a set of other similar properties. (auth)

23546 PHOTOMETRY OF THE CONTINUOUS SPECTRUM OF HD 2138. Kupo, I. D.; Mamatkazina, A. H. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 63-72(1967). (In Russian).

For the supergiant HD 21389, illuminating an anonymous reflection nebula in Camelopardalis, spectrophotometric gradients in two spectral districts and their variation were determined. The values indicate a strong reddening of the star. The results are in accordance with the data of multicolor photometry. An attempt was made to separate the interstellar and intrinsic reddening of the star. After correction for interstellar reddening the star remains abnormally red for the spectral class AO. The intrinsic reddening is interpreted in terms of the radiation of a shell, overlaying the spectrum of the star. Electron concentration and temperature of the shell are estimated. (auth)

23547 METHODS AND PRELIMINARY RESULTS OF INVESTIGATION OF ABSOLUTE ENERGY DISTRIBUTION IN THE SPECTRUM OF α LYR WITH STANDARDIZATION IN INTEGRAL SPECTRUM OF THE CENTER OF THE SUN DISK. Kharitonov, A. V.; Nelubin, N. F. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 73-81(1967). (In Russian).

In this article methods of measuring the energy distribution in the spectrum of α Lyr are described. These measurements were

carried out by means of a photoelectric spectrophotometer with a concave difraction grating. The center of the solar disk was assumed to be a standard, and the comparison with its integral spectrum (continuous spectrum together with lines) was made. The adopted energy distribution for integral spectrum of the solar disk is shown. Results of measurements agree with ones obtained in 1962. (auth)

23548 MK CLASSIFICATIONS FOR F- AND G-TYPE STARS. III. Harlan, E. A. (Univ. of California, Santa Cruz). Astron. J.; 79: No. 6, 682-686(Jun 1974).

MK spectral classifications are given for 461 stars of HD types F2-G5, and having $m_v = 7.5$ or brighter. The classifications were made on slit spectrograms of dispersion 75 A mm at Hγ. (auth)

23549 FOUR-COLOR AND Hβ PHOTOMETRY FOR OPEN CLUSTERS. X. The α Persei Cluster. Crawford, D. L.; Barnes, J. V. (Kitt Peak National Observatory, Tucson, AZ). Astron. J.; 79: No. 6, 687-697(Jun 1974).

Data are given for 89 stars, mostly B-, A-, and F-type, in the vicinity of the F51b supergiant α Persei; most are cluster members. An average interstellar reddening of $E(b-y) = 0.07$ was derived; the reddening was somewhat variable over the field. The corrected distance modulus was $V_0 - M_v = 6.1$, corresponding to 166 pc. The heavy element abundance was solar-like, and the Balmer discontinuity was found to be sensitive to rotational velocity effects. (auth)

23550 VARIABILITY OF DWARF K- AND M-TYPE STARS IN THE PLEIADES AND HYADES. Robinson, E. L. (Univ. of California, Santa Cruz); Kraft, R. P. Astron. J.; 79: No. 6, 698-701(Jun 1974).

Small variations in brightness with time scales of the order of days are found in several Pleiades dwarfs in the spectral-type range K3V-M0V; Hyades stars of similar types are constant. The brightness variations are accompanied by small or nonexistent color variations, and, thus, are probably similar to those found by Krzeminski, Chugainov, and others in field dMe-stars. Flare events are not directly responsible for the variations, even though the variations are usually found in flare stars. The material at hand suggests that brightness variations are fairly common in late K- and early M-type dwarfs of age 3×10^7 yr, but essentially disappear at an age near 5×10^8 yr. (auth)

23551 OLD DISK FLARE STARS. Veeder, G. J. (Hale Observatories, Pasadena, CA). Astron. J.; 79: No. 6, 702-704 (Jun 1974).

At least ten of the known UV Ceti-type flare stars in the solar neighborhood have old disk space motions. Five others have large space motions and are probably also members of the old disk population. The evidence of flare stars with old disk space motions and also the existence of some flare stars below the main sequence complicates the picture of these stars as a premain-sequence evolutionary stage. (auth)

23552 SOME NEW DATA ON THE RATE OF STELLAR FLARING IN THE COALSACK. MacConnell, D. J. (Wesleyan Univ., Middletown, CT); Dixon, M. S. Astron. J.; 79: No. 6, 705-707(Jun 1974).

The discovery of three new flare stars in the Coalsack region during 23.3 h of monitoring using the ultraviolet multiple-image search method is reported. The observations do not support the high rate of flaring reported by Sanduleak and by Andrews. Variability was not found for any of the stars of Andrews, nor any variable found within the area searched by him. A higher frequency of flare stars than that of Weaver was found; this may have been due to a fainter limiting magnitude. There may be a small excess of flare stars in this direction over what is expected for the distribution of UV Ceti-type stars. (auth)

23553 EFFECT OF REDISTRIBUTION ON THE EMISSION PEAKS FROM CHROMOSPHERIC-TYPE STELLAR ATMOSPHERES. Cannon, C. J.; Vardavas, I. M. (Univ. of Sydney). Astron. Astrophys.; 32: No. 1, 85-88(Apr 1974).

The equation of transfer for spectral line radiation is solved for a physically idealistic model problem involving departures from complete redistribution. In particular, a two-level atom one-dimensional atmosphere exhibiting a chromospheric-type temperature rise was considered, and emergent absorption line profiles having emission peaks similar to those observed in the core of Ca II and Mg II H and K lines were computed. A macroscopic velocity field was included and it was shown that the corresponding emergent line profiles computed assuming complete redistribution are markedly different to those obtained using the angle-averaged redistribution function for the case of pure Doppler broadening with isotropic scattering (i.e. $R_{I\text{-}A}$ in Hummer's, 1962 notation). In some cases, for example, the emission peaks obtained using complete redistribution disappear altogether when using $R_{I\text{-}A}$, and thus it is concluded that the effects of general redistribution must be taken into account when analyzing spectral lines of this type. (auth)

23554 TEMPERATURE AND VELOCITY DISTRIBUTION IN WOLF-RAYET STARS. Cannon, C. J. (Univ. of Sydney). Astron. Astrophys.; 32: No. 1, 79-83(Apr 1974).

A methodology for determining the qualitative features of the physical parameters dominating the emission line spectra observed from Wolf-Rayet stars is discussed. Although quite different arguments to those presented by Kuhi (1973) were used, the same basic conclusion was obtained, i.e., that the electron temperature in WC stars decreases with increasing radius in the region in which the emission spectra is formed. (auth)

23555 LINE FORMATION IN TURBULENT MEDIA. Gail, H. P.; Hundt, E.; Kegel, W. H.; Schmid-Burgk, J.; Traving, G. (Univ., Heidelberg). Astron. Astrophys.; 32: No. 1, 65-72 (Apr 1974).

The theory of line formation is generalized in order to take into account the influence of stochastic velocity fields. Upon the assumption that the hydrodynamic velocity can be described by a Markov process, a Fokker-Planck equation is derived for the combined probability P(x; v, I) to find at x the velocity v and the intensity I. This equation is discussed for the case that the velocity distribution is gaussian, which implies that the spatial correlation function is exponential. Solutions of the differential equation obtained in this way are discussed. In particular, it is shown that for vanishing correlation length ($l \to 0$) the usual radiative transfer equation in the limit of microturbulence is obtained, while for large correlation length ($l \to \infty$) the expression for macroturbulence is derived. In the limits of small and large l, correction terms are derived which take into account a finite correlation length. The intermediate region is investigated by numerical calculation, making use of the Schrödinger equation for a particle in a potential that is the combination of a Voigt function and the harmonic oscillator potential. (auth)

23556 LINE FORMATION IN TURBULENT MEDIA: MATHEMATICS OF PROFILE COMPUTATION. Schmid-Burgk, J. (Univ., Heidelberg). Astron. Astrophys.; 32: No. 1, 73-78(Apr 1974).

A transfer equation is derived for computing the profiles of spectral lines formed in a turbulent medium. Source function and opacity of the medium are assumed to vary slowly with optical depth as measured in the line center. The transfer equation contains two coefficients, as factors to the source term to the intensity, respectively. Formulae for rapid calculation of these coefficients are given. In particular, an analytical correction term to the usual expression of microturbulence theory is derived for the case of a small but finite ratio of photon mean free path to correlation length of the stochastic velocity field. (auth)

23557 PERIOD AND PECULIARITY OF THE COOL AP STAR HD 203006. Maitzen, H. M. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 32: No. 1, 21-28(Apr 1974). (In German).

Measurements carried out in UBV and with a multicolor medium band filter system (Maitzen, 1973) combined with uvby measurements of Morrison and Wolff (1971) yield a rotational period of 2.1219 days with epoch 2440345.32 J.D. (primary maximum in v) for the Sr-Eu-Cr star HD 203006. (WDM)

23558 ANOMALOUS REDSHIFTS IN BINARY STARS. Kuhi, L. V. (Institut d'Astrophysique, Paris); Pecker, J. C.; Vigier, J. P. Astron. Astrophys.; 32: No. 1, 111-114(Apr 1974).

The problem of the anomalous redshifts (+ 100 km/s) of the γ-velocities of Wolf-Rayet binaries as deduced from the emission lines is reviewed. The earlier explanations (Wilson, 1940 b) are rediscussed and it is shown that while the absorption hypothesis is very attractive similar redshifts can also be produced by inelastic photon boson scattering. (auth)

23559 SPECTRUM OF THE AP STAR HD 111133. I. Engin, S. (Ankara Univ.). Astron. Astrophys.; 32: No. 1, 93-101(Apr 1974).

The spectrum of the Cr-Eu-Sr Ap star HD 111133 was studied. The intensities of the Cr I, Cr II, Fe I, Fe II, Sr II lines vary in phase with the period of 16.31 days found by Wolff and Wolff (1972). λ 3933 Ca II, λ 4481 Mg II, and the Ti II lines do not vary. The radial velocity is slightly variable but it is not correlated with the period of magnetic and spectral line variations. A differential analysis by means of the curve of growth was made using o Peg, A1V, as standard star. Moreover an atmospheric model was computed using the program ATLAS 5. The results

of the rough and fine analyses were generally in good agreement. The main abundance peculiarities were the excess of Cr, Mn, Fe, Co, Sr, Eu, the modest excess of Rare Earths (with the exception of Eu), and the deficiency of Ca. (auth)

23560 RATIO OF TOTAL TO SELECTIVE ABSORPTION IN THE OPEN CLUSTER IC 2581. Moffat, A. F. J. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 32: No. 1, 103-106(Apr 1974).

Based on the ideas of Becker (1966), a quantitative method is presented which tests the reality of $R = A_V/E_{B-V}$ derived by the variable extinction method in open clusters. Applied to IC 2581 it is shown that Turner's (1973) value of $R = 5.5 \pm 0.3$ is spuriously too large. This is caused mainly by (normal) errors in the photometry. (auth)

23561 POLARIZATION OBSERVATIONS IN THE COMA CLUSTER MEL 111. Markkanen, T. (Univ. of Helsinki). Astron. Astrophys.; 32: No. 1, 89-91(Apr 1974).

The polarization of light for sixteen Coma Cluster stars was measured. The amount of polarization ranged from 0.01 to 0.10% with a mean error of ± 0.02. No correlation between polarization and intrinsic stellar parameters: magnitude, color index etc. was found. Assuming the polarization to be of interstellar origin, the corresponding lower limits of extinction and color excesses were estimated. These color-excess corrections were of the same order of magnitude as corrections based on deblanketing effects in metal-line stars. (auth)

23562 PHOTOELECTRIC INVESTIGATION OF BV 544. Leung, K. C. (Univ. of Nebraska, Lincoln). Astron. J.; 79: No. 8, 852-857(Aug 1974).

The Beta Lyrae type eclipsing system BV 544 with a spectral type of A3 was observed on seven nights in 1966. The photoelectric observations consist of 396 individual observations in yellow light and 398 individual observations in blue light. Light elements were improved and the period determined is 0.6614272 day. A consistent set of orbital elements has been obtained. The eclipse is complete. The secondary component is estimated to be a G8 star. (auth)

23563 INFRARED OBSERVATIONS OF ANONYMOUS IRC SOURCES. Strecker, D. W.; Ney, E. P. (Univ. of Minnesota, Minneapolis). Astron. J.; 79: No. 7, 797-808(Jul 1974).

Infrared (0.9 μ to 18 μ) observations of 232 anonymous 2 μ Sky survey (IRC) sources are reported. Most of the objects appear to be late type stars with little or no long wave excess. About ten percent exhibit large excesses. Thirty-one of the brightest 11 μ sources have been remeasured to determine variability. These brighter objects appear to fall into two groups; one group resembles NML Tauri and the other is like NML Cygni. (auth)

23564 PHOTOELECTRIC MEASUREMENTS OF Hγ LINE STRENGTHS IN EARLY-TYPE STARS. Blanchard, P. (Tufts Univ., Medford, MA); Bowen, W. E.; Ledden, J. E.; Pearson, E. A.; Piegorsch, W. U.; Tymon, P. A.; Urciuolo, L. R.; Ward, R.; Zawacki, D. Astron. J.; 79: No. 7, 809-814(Jul 1974).

Equivalent widths of the Hγ line in the Balmer series have been obtained from measurements of broad-band photoelectric spectral scans of 52 bright stars, ranging in spectral type from O9 to A3 and of various luminosity classes. These values are in good systematic agreement with the broad-band line strengths of Stock and, except in the cases of several A dwarf stars, are well correlated with (although some ten percent higher than) the most recent Victoria measures. Further comparisons are made with previously unpublished A-dwarf line strengths obtained recently by Gray from the photoelectric line profiles of Gray and Evans. (auth)

23565 ASTROMETRIC DETERMINATION OF THE GRAVITATIONAL REDSHIFT OF VAN MAANEN 2 (EG 5). Gatewood, G.; Russell, J. (Univ. of Pittsburgh). Astron. J.; 79: No. 7, 815-818(Jul 1974).

The astrometric parameters of van Maanen 2 and twenty-three other stars in its vicinity are determined. The true radial velocity of the white dwarf, +6 ± 15 km sec^{-1}, is determined from its acceleration in position. A comparison with the value measured by Greenstein (1972) indicates a gravitational redshift of +33 ± 16 km sec^{-1}. Adopting the photometrically determined radius of 0.013 $R_\odot$, a mass of 0.7 ± 0.3 $M_\odot$ is found. These values are consistent with the mass–radius models of Chandrasekhar and of Hamada and Salpeter. A rather large scatter in the ξ coordinate residuals of van Maanen 2 is noted; these may indicate the presence of a second body. (auth)

23566 ASTROMETRIC STUDY OF FOUR VISUAL BINARIES. Heintz, W. D. (Swarthmore Coll., PA). Astron. J.; 79: No. 7, 819-825(Jul 1974).

Revised orbital elements, parallaxes, and masses are determined for the binary stars ADS 3093, 6554, 7067, and Kpr 39. The results are summarized. The mass of the white dwarf 40 Eri B is 0.43 ± 0.02 solar masses. (auth)

23567 RADIAL VELOCITY MEASUREMENTS OF VISUAL BINARIES. I. Bakos, G. A. (Univ. of Waterloo, Ontario). Astron. J.; 79: No. 8, 866-872(Aug 1974).

About 75% of the visual binaries discussed show a variable radial velocity with an average range of 10 km/sec. The assumption is made that a large percentage of the primaries of these wide visual pairs are spectroscopic binaries. A list of individual radial velocity determinations is presented. (auth)

23568 PUPPIS CLUSTERS HAFFNER 19 AND 18ab AND THE 15 KILOPARSEC ARM. FitzGerald, M. P.; Moffat, A. F. J. (Ruhr-Univ., Bochum, Ger.). Astron. J.; 79: No. 8, 873-884 (Aug 1974).

Photoelectric and photographic photometry is presented for 584 stars in the Puppis open clusters Haffner 19 and 18abc and in the surrounding field (total area 0.065 sq deg). The clusters are located 6.9 ± 0.9 kpc from the Sun in the direction $l = 243°.1$, $b = +0°.5$. Haffner 19 (earliest observed spectral type BO) is radially symmetric; Haffner 18ab (O7) is an elongated cluster parallel to the galactic plane; Haffner 18c is probably not a real cluster. The surrounding region appears to contain many faint O and B stars at about 8 ± 1 kpc from the Sun; the approximate space densities are 25×10^{-6} pc^{-3} for o to b2.5 stars and the same for b 3 to b 6 stars. These densities are typical of an arm region, but much higher than found between 1 and 6 kpc, indicating the presence of a major spiral feature coincident with the HI Perseus extension (Davies 1972). The field stars, reddened by $E_\gamma = 0.5$ to 1.3, appear to be embedded in dust associated with the arm. The stars of Haffner 19 and 18ab are also reddened by varying amounts; however, their mean color excesses, 0.45 and 0.70, respectively, are less than the average of the surrounding region (0.90), indicating that the clusters probably lie on the inner side of the 15 kpc spiral arm. The kinematic distances of Haffner 19 and 18ab (and several H II regions at $230 < l < 245$: Georgelin et al. 1973) are substantially less than the photometric distances. (auth)

23569 SPECTROSCOPIC STUDY OF THE OPEN CLUSTER NGC 2232. Levato, H.; Malaroda, S. (La Plata Observatory). Astron. J.; 79: No. 8, 890-891(Aug 1974).

MK types were determined for 16 members of the cluster. The distance was derived as 375 pc. Only one member has a peculiar spectrum. (auth)

23570 DISTRIBUTION OF STAR CLUSTERS IN THE SMALL MAGELLANIC CLOUD. Hodge, P. W. (Harvard Coll. Observatory, Cambridge, MA). Astron. J.; 79: No. 8, 860-863 (Aug 1974).

The recently enlarged sampling of star clusters in the Small Magellanic Cloud (SMC) is examined to deduce the geometrical properties of the cluster system. A conspicuous central nonuniformity, a general, roughly elliptical main body of clusters, and an extension toward the SMC wing are found. The radial distribution of the clusters shows an exponential decrease with a gradient similar to that for the brightest stars. (auth)

23571 GRAVITATIONAL PERTURBATIONS OF SPHERICALLY SYMMETRIC SYSTEMS. II. Perfect Fluid Interiors. Moncrief, V. (Department of Mathematics, University of California at Berkeley, Berkeley, California 94720). Ann. Phys. (N. Y.); 88: No. 2, 343-370(Dec 1974).

Methods developed in a previous paper on perturbations of the Schwarzschild metric are here extended to the treatment of perturbations of perfect fluid stellar models. The perturbations of a perfect fluid sphere are explicitly decomposed into their gauge-invariant and gauge-dependent parts, and a variational principle for the perturbation equations is derived. The Hamiltonian for the perturbations is constructed and a sufficient condition for stability against nonradial, radiative perturbations is derived from it. The stability criterion is applied to two interesting classes of stellar models, polytropic white dwarf models and high-density neutron star cores with pressure proportional to energy density. (auth)

23572 NEUTRINO PAIR EMISSION BY STELLAR PLASMON–PLASMON, PLASMON–PHONON, AND PHONON–PHONON PROCESSES. Madhyastha, V.L. (Department of Physics, Fairleigh Dickinson University, Teaneck, New Jersey 07666). Phys. Rev. D 10: No. 10, 3181-3193 (15 Nov 1974).

The "self–current" interaction term appearing in the Feynman and Gell–Mann universal V–A theory of weak interaction predicts a first–order coupling between plasmons (Γ), phonons (P), and neutrino pairs (ν_e, $\bar{\nu}_e$) that leads to $\Gamma \rightarrow \nu_e + \bar{\nu}_e$ and $\Gamma + \Gamma \rightarrow \nu_e + \bar{\nu}_e$ processes, in addition to several other processes. We have computed the

pair–neutrino energy loss rates for $\Gamma + \Gamma \rightarrow \nu_e + \bar{\nu}_e$, $\Gamma + P \rightarrow \nu_e + \bar{\nu}_e$, and $P + P \rightarrow \nu_e + \bar{\nu}_e$ processes for a degenerate relativistic stellar plasma. In calculating the consequence of the axial–vector component of the weak interaction, we have assumed that the closed–electron–loop contributions are those of a vacuum rather than of a plasma. However, in using the vector component of the weak interaction, because of the charge–conjugation invariance of the vacuum that leads to a null transition matrix for the triangle–loop Feynman diagram, we employ a modified form of the electron propagator appropriate in the plasma medium. The pair–neutrino energy loss rates for $\Gamma + \Gamma \rightarrow \nu_e + \bar{\nu}_e$ and $\Gamma + P \rightarrow \nu_e + \bar{\nu}_e$ processes, although significant at $\rho > 10^5$ gm cm^{-3}, $T \geq 10^9$ °K, were found to be several orders of magnitude smaller than that corresponding to $\Gamma \rightarrow \nu_e + \bar{\nu}_e$. The energy loss rate for the $P + P \rightarrow \nu_e + \bar{\nu}_e$ process was found not only many orders of magnitude smaller compared to the other two processes, but also insensitive to temperature variations. (auth)

23573 MAGNETIC FIELD OF A CURRENT LOOP AROUND A SCHWARZSCHILD BLACK HOLE. Petterson, J.A. (Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. D 10: No. 10, 3166-3170 (15 Nov 1974).

A multipole expansion for arbitrary quasistatic axisymmetric magnetic fields in a Schwarzschild background metric is found from Maxwell's equations in curved space–time. Using this expansion, the magnetic field of a quasistatic current loop located symmetrically around a Schwarzschild black hole is obtained. The field both inside and outside the loop is calculated, and the behavior of its dipole part is shown explicitly in certain limiting cases. (auth)

23574 VIOLATION OF THE VOGT–RUSSELL THEOREM FOR HOMOGENEOUS NONDEGENERATE STARS. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA). Astrophys. J. 194: No. 3, 699-708 (15 Dec 1974).

A systematic study is made of the number and types of solutions of the equilibrium equations of stellar structure, in the case of homogeneous stars of Population I over the mass range 2–1000 $M_\odot$, with four different opacity representations. A variant of the usual "fitting" method permits the simultaneous investigation of convergence and tendency toward multiplicity of the solutions. Quadratic interpolation and extrapolation of Carson's new opacity tables produces a very large opacity at low temperature that greatly affects the loose outer layers of massive stars, while leaving the cores practically unaffected. As a result, over a small mass range, well above 100 $M_\odot$, triple solutions exist, always near an effective temperature of log $T_e \simeq 4.73$. In such a situation, a "cool" sequence of low masses overlaps a "hot" sequence of high masses, with a short "middle" sequence of intermediate masses connecting them. Multiplicity is found to be favored by a high helium abundance, a high metals abundance, and fast uniform rotation. Secular stability of the models is discussed. The close resemblance between the kinds of multiplicity found in homogeneous stars and in composite stars is pointed out. A simple classification of the known exceptions to the Vogt–Russell theorem on the uniqueness of stellar structure is given. (auth)

23575 ON THE SOLUTION OF POISSON'S EQUATION FOR RAPIDLY ROTATING STARS. Clement, M.J. (David Dunlap Observatory, University of Toronto). Astrophys. J. 194: No. 3, 709-714 (15 Dec 1974).

A two–dimensional finite–difference technique is applied to the problem of finding the gravitational potential associated with an axisymmetric density distribution. An evaluation of the effectiveness of the method is given based on calculations of polytropic models with rapid differential rotation. (auth)

23576 PULSATIONAL STABILITY OF STARS IN THERMAL IMBALANCE. IV. DIRECT SOLUTION OF DIFFERENTIAL EQUATION. Aizenman, M.L.; Cox, J.P. (Joint Institute for Laboratory Astrophysics, University of Colorado). Astrophys. J. 194: No. 3, 663-685 (15 Dec 1974).

Direct solutions, accurate to the order of (free–fall time)/(secular time), of the exact linearized partial differential equation describing the quasi–adiabatic, radial oscillations of a star in thermal imbalance, have been obtained for a number of simplified stellar models undergoing both homologous and nonhomologous secular motion. Comparison of these solutions with the results obtained by use of the integral expression approach of Cox, Hansen, and Davey and of Cox, Davey, and Aizenman for the same models, yields exact agreement as regards pulsational stability. This agreement provides, we feel, a complete and rigorous justification for the use of the much simpler integral expression approach to compute the pulsational stability of stars in thermal imbalance, at least for quasi–adiabatic oscillations. (auth)

23577 PULSATIONAL STABILITY OF STARS IN THERMAL IMBALANCE. V. EIGENSOLUTIONS FOR QUASI–ADIABATIC OSCILLATIONS. Davey, W.R. (Department of Physics, University of Queensland, St. Lucia, 4067, Queensland, Australia). Astrophys. J. 194: No. 3, 687-693 (15 Dec 1974).

An analysis of the linearized pulsation equation for quasi–adiabatic radial oscillations of stars in thermal imbalance shows that the integral expressions derived by Cox, Hansen, and Davey yield the correct eigenvalues for an arbitrary stellar model even in the case of nonhomologous secular motion. Explicit expressions for the growth rates for all modes in the case of homologous secular motion are derived directly from the differental equation for two simple analytic stellar models: the homogeneous and inverse–square models. Eigensolutions are also obtained for one example of nonhomologous secular motion and confirm the result for this case obtained by Aizenman and Cox using an asymptotic approach. (auth)

23578 A COMPARISON OF HOMOGENEOUS STELLAR MODELS BASED ON THE COX–STEWART AND CARSON OPACITIES. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA). Astrophys. J. 194: No. 3, 695-697 (15 Dec 1974).

Homogeneous stellar models in the mass range 1–120 $M_\odot$ have been constructed for two Population I chemical compositions by employing (a) the Cox–Stewart "hydrogenic" opacities and (b) the new Carson "Thomas–Fermi" opacities. The differences between the models at fixed mass and chemical composition are typically found to be (except at the highest masses) as small as the differences that are caused by the choice of linear interpolation, quadratic interpolation, or a fitted formula in the opacity tables. (auth)

23579 ARE ALL BLUE STRAGGLERS CLOSE BINARIES. Hintzen, P.; Scott, J.; Whelan, J. (Steward Observatory, University of Arizona). Astrophys. J.; 194: No. 3, 657-661 (15 Dec 1974).

Radial velocity studies for five bright blue stragglers are reported, and cluster membership is confirmed for four of them. Two of the stars show no significant radial velocity variations on a time scale of about 75 days, and two others show no significant variation on time scales of 15 and 30 days, respectively. The star for which cluster membership is uncertain may be a velocity variable. The data do not support the theory of blue straggler production involving mass transfer in a close binary. A spread in formation time of the stars in a cluster is suggested to be a plausible explanation of the blue stragglers studied. (auth)

23580 THE APSIDAL–MOTION TEST FOR MODELS OF MAIN–SEQUENCE STARS. Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA). Astrophys. J. 194: No. 3, 651-655 (15 Dec 1974).

Apsidal–motion constants, k_2, have been determined for models of homogeneous main–sequence stars constructed with the new "Thomas–Fermi" opacities of Carson. These models are similar to those constructed with the "hydrogenic" opacities of Cox and Stewart up to $\sim 7\,M_\odot$, but yield smaller values of k_2 at higher masses. Nevertheless, the new theoretical constants are still systematically too large compared with most of the empirical constants known for members of well–observed binary systems. Uniform rotation is found to lower the theoretical constants only slightly. The effect of normal evolution during core hydrogen burning, however, produces good detailed agreement with observations. The primary of α Vir is probably evolving normally if Carson's opacities are adopted. (auth)

23581 A STUDY OF AN EARLY FLARE, RADIAL VELOCITIES, AND PARALLAX RESIDUALS FOR POSSIBLE ORBITAL MOTION OF HD 103095 (Groombridge 1830). Beardsley, W.R.; Gatewood, G. (Allegheny Observatory); Kamper, K.W. Astrophys. J. 194: No. 3, 637-643 (15 Dec 1974).

Measures of radial velocity are presented. Results suggest orbital motion with periastron occuring close to 1920 and an orbital inclination close to 90°. A flare was recorded on a Thaw refractor plate obtained on 1939 April 27. The increase in brightness amounted to 0.6 mag. Positional displacement of the flared images is very small if it exists at all. A revised parallax determination together with parallax residuals covering more than 50 years is also presented. Results again suggest orbital motion with periastron occurring close to 1920. We conclude that either the M dwarf component, which has been known to flare on one other occasion, was nearly aligned in the line of sight of the G8 VI component, or that it was this component itself that flared. (auth)

23582 THE EVOLUTION OF THE HELIUM STAR SIGMA ORIONIS E. Odell, A.P. (4381 Doncaster Drive, Madison, Wisconsin). Astrophys. J. 194: No. 3, 645-649 (15 Dec 1974).

The helium–rich star σ Ori E is a member of the quintuple star σ Ori. The visual binary AB has recently been studied by Heintz, and a solution to its orbit and a distance determined. It is shown that this new distance to the system resolves the problem of too large a mass for the helium star, and allows helium–rich models to approximate the present star. The upper age to the star is 10^7 years, and with a mass of less than 5 $M_\odot$ the star must have been formed with a large helium abundance. It is unlikely that component E is the result of binary mass transfer, due to the short time scale involved. It is difficult to understand the star in terms of mass loss from a very massive star. The

idea that an original single star broke up into five stars, E being part of the original convective core, is attractive to the time scale, but the angular momentum of the present system is very large. Alternatively, the system might have resulted from the capture of E, an old star which has been completely mixed through its evolution. No completely satisfactory conclusions to this perplexing problem have been drawn. (auth)

23583 THE GAP IN THE TWO-COLOR DIAGRAM OF MAIN-SEQUENCE STARS. Böhm-Vitense, E.; Canterna, R. (Astronomy Department, University of Washington, Seattle). Astrophys. J. 194: No. 3, 629-635 (15 Dec 1974).

In the two-color diagrams of main-sequence stars a gap of $\Delta(B-V) \sim 0.07$ is expected at $B-V \sim 0.25$ due to the abrupt onset of convection. This gap is observed for field stars. It is also indicated for many clusters; however, it appears at different B-V and is less pronounced the more it is shifted to the red. Since in these clusters the stars on the blue side of the gap show large rotation, we interpret the shift as showing that large rotational velocities shift the onset of convection to lower T_{eff}. The abrupt decrease of the rotational velocities occurs at still lower T_{eff} when convective energy transport becomes important in the helium ionization zones. (auth)

23584 VISUAL AND INFRARED OBSERVATIONS OF LATE-TYPE SUPERGIANTS IN THE SOUTHERN SKY. Humphreys, R.M.; Ney, E.P. (University of Minnesota, Minneapolis). Astrophys. J. 194: No. 3, 623-628 (15 Dec 1974).

Spectral types and photometry ranging from 0.4 to 18 μ are given for 54 late-type stars, including 21 supergiants. The infrared observations of the supergiants confirm the dependence of the strength of the 10-μ silicate emission feature on the spectral type and luminosity class of the star. The long-wavelength data are also used to determine the interstellar extinction by fitting an appropriate blackbody to the infrared ($\lambda \geq 2\mu$) observations. The deviation from the blackbody at the shorter wavelengths is then attributed to interstellar absorption and absorption by TiO. This method is particularly useful when the short-wavelength photometry is contaminated by a close companion. The M supergiant AH Sco has excess radiation between 1.5 and 8 μ similar to the NML Tauri-type infrared stars. This excess energy resembles free-free emission. (auth)

23585 CIRCUMSTELLAR DUST EMISSION FROM WC9 STARS. Gehrz, R.D.; Hackwell, J.A. (Department of Physics and Astronomy, University of Wyoming, Laramie). Astrophys. J. 194: No. 3, 619-622 (15 Dec 1974).

New 2.3-μ to 23-μ measurements of WC9 stars are presented. Three of four WC9 stars appear to be embedded in thick circumstellar dust shells. Graphite is a likely major constituent of these shells. The WC9 stars may form a distinct Wolf-Rayet class, since circumstellar dust emission is not observed from other WN and WC stars. (auth)

23586 THE ABUNDANCE OF BORON AND BERYLLIUM IN ALPHA LYRAE. Boesgaard, A.M.; Praderie, F. (Institut d'Astrophysique, Paris); Leckrone, D.S.; Faraggiana, R.; Hack, M. Astrophys. J. Lett. 194: No. 3, L143-L146 (15 Dec 1974).

Copernicus satellite observations have been used to measure the equivalent width of the B II resonance line λ1362 in α Lyr. Bonsack has determined the equivalent width for a Be II resonance line λ3130. Model atmosphere analyses of α Lyr result in LTE abundances of $B/H = 1-2\times10^{-10}$ and $Be/H = 1\times10^{-11}$. The maximum possible LTE abundance of B, obtained by taking extreme values of all the atmospheric and atomic parameters, is $B/H \leq 7\times10^{-10}$, an extreme upper limit. An estimate of the non-LTE effects on these resonance lines indicates that Be is formed in LTE conditions and that the B/H ratio is 70 percent or more of the LTE value. The final abundances are $B/H \simeq 1\times10^{-10}$, $Be/H = 1\times10^{-11}$, and $B/Be \simeq 10$. It is argued that these represent the true cosmic abundances of B and Be within a factor of 3, and that both elements are produced by galactic comsic-ray bombardment of heavier elements. (auth)

23587 SPECKLE INTERFEROMETRY. III. HIGH-RESOLUTION MEASUREMENTS OF TWELVE CLOSE BINARY SYSTEMS. Labeyrie, A.; Bonneau, D. (Observatoire de Paris, Meudon, France); Stachnik, R.V.; Gezari, D.Y. Astrophys. J. Lett. 194: No. 3, L147-L151 (15 Dec 1974).

Twelve binary star systems with angular separations between 0".049 and 0".290 have been resolved. The systems δ Sco, σ Her and β Cep were found to have previously unknown stellar companions; and β Cep, β Per, and τ Per show features at the limit of resolution which may be due to circumstellar material. The masses of seven stars in four binary systems have been calculated, and the results are generally consistent with the empirical mass-luminosity relation. (auth)

23588 ON THE THERMAL PROPERTIES OF THE CONVECTIVE URCA PROCESS. Couch, R.G. (Center for Nuclear Studies and Department of Astronomy, University of Texas at Austin); Arnett, W.D. Astrophys. J. 194: No. 2, 537-539 (1 Dec 1974).

Bruenn's analysis of heating due to Urca processes during degenerate carbon burning is supplemented by consideration of the additional work necessary to maintain the convective flow. We conclude that at least initially Urca processes (especially the $^{23}Na-^{23}Ne$ pair) do stabilize degenerate carbon burning; the net effect of the convective Urca processes is cooling. (auth)

23589 PLASMA-SCREENING EFFECTS UPON ATOMIC HYDROGEN PHOTOABSORPTION. Weisheit, J.C.; Shore, B.W. (Lawrence Livermore Laboratory, University of California). Astrophys. J. 194: No. 2, 519-523 (1 Dec 1974).

We present oscillator strengths and photoionization cross-sections of an electron bound by a Debye potential, $V(r) = -(1/r)\exp(-r/D)$, for a range of Debye lengths D. All photoionization cross-sections vanish at threshold, and near series limits the strengths of bound-bound transitions fall well below hydrogenic values. We discuss the relevance of these calculations to the interpretation of Balmer line spectra in stellar atmospheres. We also note the effects of plasma screening on line blanketing and on bound-free opacities. (auth)

23590 HIGH-DISPERSION SPECTROSCOPIC OBSERVATIONS OF HD 77581, A CANDIDATE FOR VELA XR-1 (2U 0900-40). Wallerstein, G. (Astronomy Department, University of Washington, Seattle). Astrophys. J. 194: No. 2, 451-457 (1 Dec 1974).

Using high-dispersion spectra obtained at the Mauna Kea and Cerro Tololo Observatories radial velocity curves have been derived for the 8.95-day binary HD 77581. Consistent orbital elements cannot be derived, and several possible solutions are suggested. The range of possible mass functions is from 0.010 to 0.082. Combining theses with a reasonable range of masses for the BO.5 Ib primary of 10-30 $M_\odot$ yields a range of masses for the X-ray source from 1.07 to 4.6. $M_\odot$ (auth)

23591 THERMODYNAMIC STABILITY OF RELATIVISTIC ROTATING STELLAR CONFIGURATIONS AND A MAXIMUM PRINCIPLE FOR THE ENTROPY. Katz, J.; Horwitz, G. (The Racah Institute of Physics, The Hebrew University, Jerusalem, Israel). Astrophys. J. 194: No. 2, 439-449 (1 Dec 1974).

We formulate thermodynamic criteria of stability for isolated self-bound (general) relativistic rotating stellar structures in thermodynamic equilibrium. Expressing global thermodynamics in terms of conserved vector densities is the basis on which thermodynamic maximum criteria for the entropy are developed. Inequalities are given as necessary conditions of stability in both a local form and a global form. It is proved that the total entropy of such a system in equilibrium must be maximum with respect to total energy, angular momentum, and particle number. As one illustration the rotating gas in special relativity is shown to have a stable equilibrium for nonzero temperature. Applicability of maximum-entropy configurations to astrophysical systems is discussed. Preliminary results are also given of an application to spherical clusters of collisionless stars. (auth)

23592 TIME-DEPENDENT ACCRETION DISKS AROUND COMPACT OBJECTS. I. THEORY AND BASIC EQUATIONS. Lightman, A.P. (California Institute of Technology). Astrophys. J. 194: No. 2, 419-427 (1 Dec 1974).

We consider accretion disks around compact stars and black holes, generalizing the stationary disk models of various authors to allow time dependence on the radial-flow time scale. The structure and evolution of the disk are governed by an "evolution equation" for matter surface density Σ (r,t), plus a set of implicit algebraic equations determining various thermodynamic and radiation variables in terms of Σ. The analytic structure of these equations is studied. It is shown that there exists a maximum permissible value of the surface density $\Sigma_{crit}(r)$, at which gas and radiation pressure are approximately equal, and beyond which viscosity generates more energy than radiative transport can remove. (auth)

23593 TIME-DEPENDENT ACCRETION DISKS AROUND COMPACT OBJECTS. II. NUMERICAL MODELS AND INSTABILITY OF INNER REGION. Lightman, A.P. (California Institute of Technology). Astrophys. J. 194: No. 2, 429-437 (1 Dec 1974).

Using the theory of time-dependent accretion disks developed in a previous paper, we numerically solve, for various examples, the time evolution equation for disk surface density Σ; from Σ all other variables of the disk may be calculated by algebraic equations. From both analytic considerations and numerical results we find that the "inner region" of a disk around a black hole is secularly unstable against clumping of the gas into rings. This invalidates the standard steady-state theory of such disks. Possible revisions of the theory are suggested. For accretion onto a magnetized neutron star, we study how the evolution of the disk is affected by time varying deposition of gas into the disk, and by changes in location of the Alfvén surface (magnetosphere-disk interface). Finally, we describe briefly some possible implications of our results for models of the binary X-ray sources Cyg X-1, Her X-1, and SMC X-1. (auth)

23594 THE URCA PROCESS IN DENSE STELLAR INTERIORS. Couch, R.G. (Center for Nuclear Studies and Department of Astronomy, University of Texas at Austin); Loumos, G.L. Astrophys. J. 194: No. 2, 385-392 (1 Dec 1974).

An investigation has been made to determine the effect which the Coulomb interaction energy between an ion and the background plasma has on the Urca process in dense stellar interiors. It was found that the change in interaction energy which occurs when an ion changes its charge by one unit can increase significantly the threshold for electron capture. The exact threshold depends on the particular ionic configuration which exists at the time the $\beta-$interaction occurs. There thus exists a distribution of possible thresholds about some mean value. Monte Carlo techniques were used to investigate this distribution. The effect on the energy generation rate of the Urca process was found to be small. The thermal effects of the Urca process are discussed, and calculations are presented which indicate several interesting properties of the convective Urca process. (auth)

23595 NONLINEAR, ADIABATIC NONRADIAL STELLAR PULSATION: CALCULATION AND APPLICATIONS. Deupree, R.G. (David Dunlap Observatory, University of Toronto). Astrophys. J. 194: No. 2, 393-401 (1 Dec 1974).

The computational problem of nonlinear, nonradial, adiabatic stellar pulsation is examined. The successes and failures of several types of difference approximations to the stellar pulsation equations are outlined and illustrated with test models. The best method of solution is applied to the beat phenomenon in the β Cephei stars where it is found that in the presence of rotation two modes may be present. It is further indicated that these two modes interact when the frequencies of oscillation are sufficiently close. However, it cannot be definitely concluded that a second mode may be excited when only one mode is initially present, as both modes must be present to some extent in any initial velocity distribution. (auth)

23596 STUDIES OF EVOLVED STARS. IV. BAND STRENGTH RATIOS AS INDICATORS OF MIXING IN M, MS, AND S STARS. Scalo, J.M. (University of California, Los Angeles; and California Institute of Technology). Astrophys. J. 194: No. 2, 361-372 (1 Dec 1974).

Evidence is presented which indicates that many apparently normal cool giants have undergone mixing between the stellar interior and the surface. The results are based on a comparison of chemical equilibrium calculations with published band strengths of YO, ScO, TiO, CO, and CN, and are supported by observations of anomalous isotopic ratios and the presence of technetium in several such stars. Methods for distinguishing between two general mixing mechanisms are discussed. The available evidence suggests that 3α carbon has been added to the envelopes of at least some M and S stars. It is also concluded that the C/O ratio in S stars is greater than 0.96, if the oxygen abundance is solar, and that the strong CN bands observed in S stars can be understood as a result of an increase in C/O, without large nitrogen enhancements. A number of molecular bandstrength ratios which could be measured in the blue and visual regions of the spectrum are suggested for detection of C/O variations in M giants. (auth)

23597 ADVANCED EVOLUTION OF MASSIVE STARS. VI. OXYGEN BURNING. Arnett, W.D. (Department of Astronomy, University of Texas, Austin). Astrophys. J. 194: No. 2, 373-383 (1 Dec 1974).

Evolutionary sequences of massive helium stars (M_a = 4, 8, 16, and 32 $M_\odot$) are continued through oxygen burning and up to ignition of silicon burning in the center. During these stages the time scale becomes too short for convection to be regarded as beginning instantaneously or to cause mixing at infinite velocity. For M_a = 4 and 8 M—, a complex neon–oxygen flash occurs after ignition of ^{16}O + ^{16}O in the center. Strong shell flashes occur until the cores are large enough to ignite silicon burning. (auth)

23598 POSSIBLE ABUNDANCE DIFFERENCES AMONG GIANT STARS IN NGC 188. McClure, R.D. (Yale University Observatory). Astrophys. J. 194: No. 2, 355-360 (1 Dec 1974).

B and V observations of 10 stars on the giant branch of NGC 188 confirm the large scatter shown by the color–magnitude diagram of Sandage and Eggen and Sandage. Intermediate–band photometry on the DDO system indicates that this scatter is intrinsic to the stars and may be due to differences in heavy–element abundance. The intermediate–band photometry has been used to obtain an independent value of reddening for the cluster and confirms the low value obtained by Eggen and Sandage. The mean value of the cyanogen anomaly δCN for the giants in NGC 188 is identical to that for solar–neighborhood field giants, and weaker than that for the Hyades cluster giants. (auth)

23599 ELEMENT IDENTIFICATIONS IN FIVE Ap STARS. Cowley, C.R.; Hartoog, M.R.; Cowley, A.P. (University of Michigan, Ann Arbor). Astrophys. J. 194: No. 2, 343-354 (1 Dec 1974).

We have examined 2 Å mm^{-1} spectra of β CrB, 73 Dra, 78 Vir, HR 4816, and HR 4072 for the presence of some 74 elements. The technique combines traditional line–identification methods with a Monte Carlo analysis of wavelength coincidences. The identifications are divided into three categories: definite, good, and possible. A majority of the discussion is devoted to the latter category. In many instances, the lines in question arise from more than 10 eV so that a positive identification alone would imply a large abundance excess. Elements in this category which may be present in one or more of the five stars are Al, S, Kr, and a few others. A high significance level was found for Pt in HR 4072. The statistical results for Pt and U were negative or weak in all other cases but the tracings provide some evidence for the presence of these elements. No evidence was found for Pm, or any of the transuranic elements. (auth)

23600 MAGNETIC ACCRETION AND ATMOSPHERIC PECULIARITIES IN EARLY TYPE STARS. Havnes, O. (Univ. of Oslo). Astron. Astrophys.; 32: No. 2, 161-176(May 1974).

The magnetic accretion theory (Havnes and Conti, 1971) for magnetic peculiar A stars is tested quantitatively. Magnetic stars accrete atoms and ions from the interstellar gas. The accretion rate of different elements is dependent on their ionization state as the gas encounters the stellar magnetosphere. The ionization state of the gas around stars whose effective temperatures range from 8000 to 14000°K is calculated as are also the grain temperatures and evaporation times of grains. Elements which are locked in grains may have a low probability of capture. The ions of the interstellar gas which are acted upon by the electromagnetic forces of the rotating stellar magnetic field may enter the magnetosphere where they describe a spiral orbit. If an ionization takes place the ion becomes trapped. The neutral elements entering the magnetosphere describe hyperbolic orbits there and trapping also results after an ionization. Rates of trapping of different elements were calculated and it was found that magnetic accretion in fairly dense regions of space upwards of 10 particles cm^{-3} may be required in order to form on the star abundance peculiarities sufficiently rapidly. The calculated abundance peculiarities formed by magnetic accretion are generally found to be in good agreement with the observed values. The largest discrepancies between observation and theory are found for Ca and Sc in the cooler Ap stars. It is not unlikely that this results from a tendency for Ca and Sc to be locked in grains. (auth)

23601 STELLAR EVOLUTION NEAR THE MAIN SEQUENCE: ON SOME SYSTEMATIC DIFFERENCES BETWEEN CLUSTER SEQUENCES AND MODEL CALCULATIONS. Maeder, A. (Observatoire de Geneve). Astron. Astrophys.; 32: No. 2, 177-190 (May 1974).

Detailed comparisons in the color–magnitude diagram were made between computed isochrones and observed sequences of some well known old open clusters, namely NGC 188, M 67, NGC 3680, NGC 752, NGC 2360, and Praesepe. As basic data, different evolutionary models were considered, calibrations T_{eff} confirmed by recent models and the numerous results on the abundances of the clusters; the effects of the spread due to binaries were also examined. The comparisons showed that, despite the well known overall agreement between models and observations, there exist some clear and systematic differences concerning mainly the shape of the sequences in the rapid phase of core hydrogen exhaustion (or phase of overall contraction). The hook predicted by the evolutionary models is absent; this leads to a gap occurring vertically in the color–magnitude diagram with a top lying much farther from the zero-age sequence than predicted. As these anomalies concern differential measurements, they are essentially free from the uncertainties of stellar atmospheric factors and interstellar reddening; moreover, they are unexplainable in terms of helium and metal contents. Concerning the origin of this situation, several arguments are given which tend to support that the observed differences result from effects related to the convective mixing of stellar cores. (auth)

23602 $^2\Pi_{\frac{1}{2}}$, J = ½ STATE OF OH, AND THE INFRARED STARS ASSOCIATED WITH H_2O/OH MICROWAVE EMISSION. Baudry, A. (Univ. of California, Berkeley). Astron. Astrophys.; 32: No. 2, 191-195(May 1974).

Significant upper limits to the 6 cm $^2\Pi_{\frac{1}{2}}$, J = ½ transitions of OH have been obtained in infrared stars displaying H_2O microwave emission and in some unusual OH sources (1612 MHz/OH star-like sources). The absence of strong excited-state OH lines in stars is used to derive some circumstellar physical parameters, and to show that the OH gas component must be far from the star. In connection with the lack of strong 6 cm emission, arguments are given to suggest that low gas density and collisional pumping models may account for basic properties in type I OH stars. (auth)

23603 SECULAR STABILITY OF STARS WITH CENTRAL HELIUM BURNING. Gabriel, M.; Refsdal, S.; Ritter, H. (Hamburg Sternwarte). Astron. Astrophys.; 32: No. 2, 217-221(May 1974).

A complete secular stability analysis, including a search for complex eigenvalues, was performed for central He-burning stars of 7 $M_\odot$ and 9 $M_\odot$, and with l/H_p = 1.5. For the 9 $M_\odot$ star

it was found that three static solutions with central He-burning are possible for certain chemical profiles, and that two of these solutions are secularly stable, whereas one is unstable. When only one static solution with central He-burning is allowed for a given chemical profile, the solution is always found to be secularly stable. This occurs often for 9 $M_\odot$ and always for 7 $M_\odot$ in the investigation. (auth)

23604 THERMAL-CONVECTIVE INSTABILITY OF A STELLAR ATMOSPHERE WITH HALL EFFECTS. Sharma, R. C. (Himachal Pradesh Univ., Simla, India). Astron. Astrophys.; 32: No. 2, 223-225(May 1974).

Thermal-convective instability of a stellar atmosphere has been considered to include Hall effects in the presence of a uniform vertical magnetic field. The criterion for monotonic instability has been found to be unchanged by the presence of Hall effects. (auth)

23605 ROTATION IN LATE STAGES OF STELLAR EVOLUTION. Hardorp, J. (State Univ. of New York, Stony Brook). Astron. Astrophys.; 32: No. 2, 133-136(May 1974).

Empirical arguments favor the view that the inner core of a star exchanges angular momentum with the envelope during evolution. (auth)

23606 2700 MHz MAP OF IC 434 AND THE SURROUNDING ORION REGION. Caswell, J. L.; Goss, W. M. (CSIRO, Sydney). Astron. Astrophys.; 32: No. 2, 209-216(May 1974).

A 2700 MHz map of a region extending from Orion A (NGC 1976) to Orion B (NGC 2024) is presented; it shows extensive weak emission, predominantly from the faint diffuse nebula IC 434. The sensitivity is comparable with that of existing optical photographs and the radio contours show good agreement with the extent of optical emission. Quantitative comparisons of radio and optical observations of IC 434 suggest that its electron temperature is less than 3500 K. Four of the nebulae in the Orion region are believed to be excited by relatively "cool" (spectral type O9.5 and later) stars. The uv fluxes from these stars may be estimated using the excitation parameters implied by the radio flux densities; for the coolest stars, they prove to be quite high, more in agreement with earlier predictions than with the most recently published calculations. (auth)

23607 EQUILIBRIUM STRUCTURES OF RELATIVISTIC STAR CLUSTERS. Occhionerr, F. (Univ., Rome); San Martini, A. Astron. Astrophys.; 32: No. 2, 203-208(May 1974).

The spherically symmetric equilibrium structures available to a monoenergetic collection of point masses under the influence of their own gravity were investigated in extreme relativistic conditions. The family of solutions, parametrized by R_s/R, the ratio between the Schwarzschild and the coordinate radius (or equivalently by z_c, the central redshift), attains a 3.6% maximum of the fractional binding energy for $R_s/R \cong 0.3 (z_c \cong 0.5)$. Beyond this limit the relativistic cluster is probably dynamically unstable for radial perturbations and therefore uninteresting from an astrophysical point of view. On the contrary, the equilibrium sequence for $0 \cong R_s/R \cong 0.3$ represents a possible evolutionary track for quasi-static contraction. (auth)

23608 MORE ABOUT THE NUCLEOSYNTHESIS OF THE NUCLEI BETWEEN CARBON AND NEON. Arnould, M.; Beelen, W. (Brussels Univ. (Belgium). Inst. d'Astronomie et d'Astrophysique). Astron. Astrophys.; 33: No. 2, 215-230(Jul 1974).

We study the explosive processing of four compositionally different types of layers possibly surrounding an evolved C–O stellar core. It appears that the explosive burning of so-called CNO layers (zones partially depleted with hydrogen before the explosion essentially by the operation of the low-temperature CNO cycle) can lead in the most favorable conditions to the production in their solar relative amounts of ^{13}C, ^{14}N, ^{15}N, ^{17}O, ^{21}Ne and ^{22}Ne; alternatively, the explosive processing of certain CNO layers might perhaps provide an explanation for the origin of the low-abundance trapped neon component with $^{20}Ne/^{22}Ne \leq 3.4$ observed in various C1 and C2 carbonaceous chondrites. The limiting cases of a CNO layer, i.e., undepleted or totally depleted hydrogen zones, are also considered. (GE)

23609 THE DISTANCE AND ABSOLUTE MAGNITUDE OF THE SUPER–LITHIUM S STAR T SAGITTARII. Culver, R.B. (Department of Physics, Colorado State University); Ianna, P.A. Astrophys. J. Lett. 195: No. 1, L37-L38 (1 Jan 1975).

The result of photoelectric and spectroscopic observations of the S star T Sgr at minimum light are presented. A distance to the system of 1.0 kpc, an absolute visual magnitude of −2.4 at maximum light, and a lower mass limit of 1.5 $\mathfrak{M}_\odot$ are derived for T Sgr. (auth)

23610 PHOTOMETRIC PROPERTIES AND EVIDENCE OF DUPLICITY FOR SZ LYNCIS. Barnes, T.G. III; Moffett, T.J. (Department of Astronomy and McDonald Observatory, The University of Texas at Austin, Austin, Texas 78712). Astron. J. 80: No. 1 48-55 (Jan 1975).

UBV photometry with a time resolution of 20 sec is reported for the AI Vel variable, SZ Lyn. The reported irregularities in height of maximum light are confirmed and found to have a total amplitude ~0.04 mag. No periodic amplitude modulation is observed. It is demonstrated that the colors of SZ Lyn are normal for its spectral type and luminosity class. The periodic variation from a linear ephemeris found by van Genderen is confirmed and its parameters improved. The most plausible interpretation of this periodicity is a light–travel–time effect, leading to the prediction that SZ Lyn is a single–lined spectroscopic binary with period 3.14 yr and total velocity amplitude 19 km/sec. (auth)

23611 MOTION OF GRAINS IN ENVELOPES OF MIRA VARIABLES. Maciel, W. J. (Universidade de Sao Paulo, Brasil). Astrophys. Lett.; 15: No. 4, 177-180(Dec 1973).

The motion of silicate grains in the envelopes of Mira variable stars is computed. Charged and uncharged grains are considered. In both cases the escape time is found to be greater than the pulsation period of the star. This places some restrictions on the survival of the grains in the envelope. (auth)

23612 SEARCH FOR OH EMISSION FROM RV TAURI STARS. Bowers, P. F.; Cornett, R. H. (Univ. of Maryland, College Park). Astrophys. Lett.; 15: No. 4, 181-183(Dec 1973).

A search was made for OH emission from RV Tauri stars, some of which are known to have large infrared color excesses. No OH emission was detected to the limit of ~1 flux unit (or Jansky). Possible explanations for the absence of emission are discussed. (auth)

23613 STRUCTURE OF NEUTRON STARS. Moszkowski, S. V. (Univ. of California, Los Angeles). Astrophys. Lett.; 15: No. 4, 159-162(Dec 1973).

Results are presented for the equation of state of neutron-star matter, including neutrons, protons, electrons, and hyperons, at supernuclear densities, and of the connection between gravitational mass, radius, and central density of spherical nonrotating neutron stars. These relations are derived from a model, discussed in a separate paper, that uses realistic nucleon–nucleon and semi-realistic hyperon–nucleon interactions. A radius between 9 and 10 km over a wide range of densities, a maximum gravitational mass of 1.76 solar masses, and a maximum rotational moment of inertia 45 $M_\odot$ km^2 were found. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 23517, 23606, and 23692.

23614 SUPERNOVA EXPLOSIONS IN CLOSE BINARY SYSTEMS, WITH AN APPLICATION TO CENTAURUS X-3. Sutantyo, W. (Univ. of Amsterdam). Astron. Astrophys.; 31: No. 3, 339-342(Mar 1974).

The effect of a spherically symmetric supernova explosion on the orbital period of a close binary system is considered. Simple approximation of the effect of the impact is included. The upper and lower limit of the mass ratio before the explosion can be determined from current theories of close binary evolution. It is shown that the final period (after the explosion) as estimated from observational data, yields an order of magnitude estimate for the upper limit of the ejection velocities of the supernova shell. Application to the neutron star in the x-ray binary Cen X-3 indicates that this star is likely to have originated in a Type II supernova with an ejection velocity of the order of 10^9 cm/s. (auth)

23615 REFLECTION AND REPROCESSING OF X-RAY SOURCE RADIATION BY THE ATMOSPHERE OF THE NORMAL STAR IN A BINARY SYSTEM. Basko, M. M. (Inst. of Applied Mathematics, Moscow); Sunyaev, R. A.; Titarchuk, L. G. Astron. Astrophys.; 31: No. 3, 249-263(Mar 1974).

In a close binary system, up to 30% of the x-ray source radiation reaching the surface of the normal star is reflected. The remaining 70% is absorbed and is subsequently re-radiated as optical and ultraviolet radiation. The case of a semi-infinite plane atmosphere in a stream of hard x rays is considered, and the x-ray transfer equation is solved numerically. Photoabsorption and Compton scattering are taken into account. The albedo of the reflected x rays is found along with their spectral, polarizational, spatial and temporal (for a pulsation primary flux) characteristics. The results obtained are discussed with specific reference to Her X 1, Cyg X3 and 2U 1700-37. It is noted that

there may well exist x-ray sources which are weak at about hν ~ 2 to 6 keV, but bright at hν ~ 15 to 20 keV: in the case of Her X1, there is an interval of 24 days (out of a total of 36) when the Earth is not in the beam of the x-ray pulsar: the system is then visible only by virtue of the x-ray flux reflected by the surface of HZ Her, and it may then be such a source. It is noted also that the transformation of soft x rays in the atmosphere of HZ Her cannot account for its optical variability which, however, can be easily explained by the reprocessing of hard x rays. Two sources of the optical fluctuations of HZ Her = Her X1 are also discussed. (auth)

23616 COMMENTS ON MAGNETIC ACCRETION AND HER X−1. Henriksen, R. N. (Univ. of Sussex, Eng.); Reinhardt, M. Astron. Astrophys.; 31: No. 2, 195-201(Mar 1974).

This paper is a sequel to the investigation by Henriksen et al. (1973) on magnetic accretion with special emphasis on Her X−1. The present work was necessitated by new observations of Her X−1, which support both, the theory of magnetic accretion and the model of the x-ray binary. First some general physical properties of magnetic accretion are discussed, which were only touched upon, or not treated at all in the first paper, especially the occurrence of critical points in the matter flow and a classification of the different modes of accretion by the sign of the total specific angular momentum of the infalling matter. An explanation for sign reversals in the time derivative of the pulsation period of accreting x-ray sources in binaries is given. The rôle of external magnetic fields trapped in the accreted material is discussed. A magnetically determined lower limit of the accretion rate is derived. The evidence for supercorotation of an active region on the optical companion of the x-ray source in Her X−1 in the light of recent x-ray and optical observations is discussed in some detail. Possible explanations for the weak sensitivity of the optical intensity variations over the 35 d cycle are investigated, including one based on the existence of a deep convection zone in the optical companion. The fact that the "turn-on" of the x rays in the 35 d cycle occurs around fixed phases in the 1.7 d cycle finds a natural explanation within the model of the system. A physical mechanism is offered for the generation of the optical pulses and a determination of the locus of their origin. Several observational checks of the model for the system are proposed. (auth)

23617 SEARCH FOR OH ABSORPTION IN THE SPECTRUM OF PSR 0329 + 54. Galt, J. A. (Onsala Space Observatory, Sweden). Astron. Astrophys.; 31: No. 2, 235(Mar 1974).

The pulsar's spectrum was measured at the 1.667 GHz OH line over the region in which absorption lines would be spread by galactic rotation. At a resolution of 1.8 km s^{-1} no absorption was detected to a limiting rms optical depth of 0.1 (2.5 times the rms deviation). (auth)

23618 CATALOG OF SMALL-DIAMETER RADIO SOURCES CLOSE TO THE GALACTIC PLANE. Clark, D. H.; Crawford, D. F. (Univ. of Sydney). Aust. J. Phys.; 27: No. 5, 713-727 (Oct 1974).

A catalog of "small-diameter" galactic radio sources observed at a frequency of 408 MHz with the Molonglo radiotelescope is presented. The catalog covers an area of 0.40 sr enclosed in the range $l^{II} = 190° - 360° - 50°$, $|b^{II}| \leq 3°$. The sources listed are those which show no significant broadening of the ~3′ arc aerial beam. Small-diameter features bounded or confused by extended regions of emission are not included. A total of 513 sources are listed above a flux density of 0.6 Jy. While most of these are expected to be extragalactic, the list includes some known pulsars and small-diameter HII regions. The catalog should form a useful search list for the identification of other such galactic objects. (auth)

23619 FLUX-DENSITY MEASUREMENTS OF SELECTED RADIO SOURCES RELATIVE TO CASSIOPEIA A AT 21.84 GHz. Klein, M. J. (Jet Propulsion Lab., Pasadena, CA). Astron. J.; 79: No. 2, 139-143(Feb 1974).

New measurements of the flux-density ratios of DR 21 and six other radio sources relative to Cassiopeia A at 21.84 GHz are reported. Based on the assumption that the flux density of Cas A was 266.6 flux units at the mean epoch 1971.1, the flux densities of the program sources are 18.6 ± 1.4 f.u. for DR 21, 420 ± 28 f.u. for Taurus A, 300 ± 10 f.u. for Orion A, 448 ± 50 f.u. for M 17, 56.5 ± 4.0 f.u. for Cygnus A, 21.7 ± 1.6 f.u. for Virgo A, and 41.2 ± 2.5 f.u. for 3C173, The DR 21 flux density agrees with the short wavelength flux-density scale proposed by Dent. The fluxes of the other sources are consistent with their extrapolated spectra except Cygnus A, which appears to exhibit a microwave spectrum with greater convex curvature than previously believed. (auth)

23620 OHIO SURVEY. VI. Ehman, J. R.; Dixon, R. S.; Ramkrishna, C. M.; Kraus, J. D. (Ohio State Univ., Columbus). Astron. J.; 79: No. 2, 144-317(Feb 1974).

A 1415 MHz continuum survey with the Ohio State University 110 by 21-m radio telescope was made between declinations of 0° and 40° North and between 25° and 31° South covering 8190 deg^2 of sky. This is the sixth installment of the Ohio Survey. It fills large gaps in some of the declination zones of the five previously published installments of the survey. There are 81 maps of the regions surveyed and a list of 5955 sources at or above 0.18 flux units. Of these sources, 3060 are previously uncataloged. The six installments include a total of 17,110 sources in 7.70 steradians of sky. Results of a Monte Carlo analysis to determine the erros in flux density and position are presented. (auth)

23621 OBSERVATIONS WITH THE RRE INTERFEROMETER OF RADIO SOURCES IN THE NRAO STRONG SOURCE SURVEY. Adgie, R. L. (Royal Radar Establishment, Worcester, Eng.). Astron. J.; 79: No. 8, 846-851(Aug 1974).

Observations were made with the interferometer of the Royal Radar Establishment, Malvern, to obtain accurate radio positions for 161 sources selected from the 5-GHz Radio Source Survey made at the National Radio Astronomy Observatory, Green Bank. For most of the sources the standard error of measurement is about 0.5 arcsec in both coordinates. (auth)

23622 TV PHOTOMETRY OF EMISSION LINES IN THE CRAB NEBULA. Davidson, K. (Princeton Univ., NJ); Crane, P.; Chincarini, G. Astron. J.; 79: No. 7, 791-796(Jul 1974).

Using an integrating-television method, photometry of the Crab Nebula was attempted in the light of the Hβ, [O III], and [O I] emission lines. The Hβ and [O III] fluxes from the whole nebula may be larger than previously estimated. Considering the results, the very difficult problem of finding the mass of the Crab Nebula is discussed. (auth)

23623 ON THE INTERPRETATION OF THE INTERFEROMETRIC MAPS OF H_2O MASERS NEAR H II REGIONS. Kwan, J. (Institute for Advanced Study); Thuan, T.X. Astrophys. J. 194: No. 2, 293-300 (1 Dec 1974).

Two interpretations of the interferometric maps of the H_2O masers in Orion, W49 and W3 OH, are possible: first, that maser action occurs only at the maser spots each of which represents an individual source; and second, that population inversion of the maser levels occurs over the whole region in which the maser spots are found and that the latter are but manifestations of those paths along our line of sight that are most favorable for amplification. Arguments on possible pump mechanisms, the apparent sizes, and variabilities of the H_2O masers are put foward to discriminate between the two interpretations. We believe that the second interpretation is unlikely to be correct. (auth)

23624 FREQUENCY SHIFTS IN MATTER FALLING INTO A BLACK HOLE. Trümper, M.; Wayland, J.R. (Department of Physics, Texas A&M University, College Station, Texas 77843). Phys. Rev. D 10: No. 12, 3931-3936 (15 Dec 1974).

We consider luminous test particles which are falling radially into a Schwarzschild black hole from rest at infinity. For an observer traveling with the particles inside of the horizon, we calculate the frequency shift of light received from sources in various directions and at positions up to r = 5m. The differential equations for the particles and the photons are set up in Kruskal coordinates. They are valid both inside and outside the horizon. We find exclusively red shifts in radial directions. For light from off−radial directions we find blue shifts in the vicinity of the observer, but increasing red shifts for sources further out. This behavior of frequency shifts is similar to that seen by comoving observers outside of the horizon. (auth)

23625 QUANTUM−MECHANICAL UNCERTAINTIES IN THE MEASUREMENT OF MASS, CHARGE, SPIN, AND MULTIPOLE MOMENTS OF A BLACK HOLE. Ohanian, H.C. (Rensselaer Polytechnic Institute, Troy, New York 12181); Ruffini, R. Phys. Rev. D 10: No. 12, 3903-3905 (15 Dec 1974).

By considering a set of gedanken experiments we show how quantum mechanics imposes uncertainties on the mass, charge, spin, and multipole moments of a black hole. In the case of mass and charge the only limitation on the precision of the measurement arises from the size of the universe. However, in the case of the spin the limitation on the measurability arises from the intrinsic properties (horizon) of the black hole. The uncertainty in the spin is always larger than ħ/2. It is shown how the mass, charge, and spin of the black hole have to be considered as purely classical parameters deprived of any quantum property. (auth)

23626 THE NATURE OF CYGNUS X−3 RADIO OUTBURSTS FROM AN ANALYSIS OF RADIOFREQUENCY SPECTRA. Gregory, P.C. (Physics Department and Institute of Astronomy, University of British Columbia, Vancouver); Seaquist, E.R. Astrophys. J. 194: No. 3, 715-723 (15 Dec 1974).

Radiofrequency spectra of Cygnus X−3, between 0.4 and 22.2 GHz,

have been compiled at 17 epochs during the "giant radio outbursts" of 1972 September. Assuming that synchrotron radiation is responsible for the emission process, four absorption mechanisms have been considered to account for the low-frequency turnover of the spectra: (a) self absorption by the radiating relativistic particles, (b) free-free absorption by a thermal plasma uniformly mixed with radiating particles, (c) free-free absorption by a thermal plasma surrounding the radiating particles, and (d) the effect of a dispersive medium on the synchrotron emission process. From a least squares analysis, (b) is found to provide the best overall fit to the observed spectra. The results of the spectra analysis provide a useful test of models proposed to explain the temporal variations of the flux density of Cygnus X-3 during an outburst. In particular the present analysis appears to be more consistent with the Aller and Dent model than the adiabatic expanding models proposed by Gregory et al. and Peterson. The analysis also leads to a lower limit on the source size near the peak of an outburst of 0.001 (or 10^{14} cm) increasing to 0.01 (10^{15} cm) near the end of an outburst. The estimated mass of thermal plasma requires is $\sim 10^{-6}\ M_\odot$, or approximately 10^3 times the mass of relativistic particles. (auth)

23627 COLOR-DIFFERENCE PHOTOMETRY OF THE CRAB NEBULA PULSAR AND THE ROTATING RELATIVISTIC VECTOR MODEL. Cocke, W.J.; Ferguson, D.C. (Steward Observatory, University of Arizona). Astrophys. J. 194: No. 3, 725-731 (15 Dec 1974).

Light curves of the Crab Nebula pulsar in U and V are given, as are normalized difference curves for the main and secondary pulses. The ratios of total intensity for main to secondary are: 1.866±0.004 for U, and 1.916±0.004 for V. The intensity difference curve for the secondary pulse is fitted by the rotating relativistic vector model. Timing errors prevent a fit for the main pulse. (auth)

23628 DETECTION OF A STRONG AND POSSIBLY VARIABLE COMPACT MILLIMETER WAVE COMPONENT IN CENTAURUS A. Kellermann, K.I. (National Radio Astronomy Observatory). Astrophys. J. Lett. 194: No. 3, L135-L137 (15 Dec 1974).

A surprisingly strong radio source which is probably variable on very short time scales has been observed at millimeter wavelengths near the nucleus of the radio galaxy Centaurus A (NGC 5128). This apparently opaque and compact component emits only a few percent of the total radiated power, but suggests the presence of a large source of energy at the galactic nucleus. (auth)

23629 LIMITATIONS ON THE MASSES AND OTHER DIMENSIONS OF THE BINARY HD 77581. Mikkelsen, D.R.; Wallerstein, G. (University of Washington, Seattle). Astrophys. J. 194: No. 2, 459-463 (1 Dec 1974).

The mass of the X-ray source 2U 0900-40 is found to be ~2 $M_\odot$. This object could, therefore, play an important role in the determination of the maximum mass of neutron stars and thereby test strong field predictions of gravitational theories. It is shown that the X-ray eclipse angle can be used to derive a lower limit for the mass ratio M_p/M_x. All reported eccentric elements for HD 77581 are found to conflict with the width of the observed eclipse. The mass and radius of the primary are found to be ~20-25 $M_\odot$ and ~30$R_\odot$. (auth)

23630 ON THE PASSAGE OF RADIATION THROUGH INHOMOGENOUS, MOVING MEDIA. XI. NONLINEAR EFFECTS ON RAY PATHS IN THE GEOMETRICAL OPTICS APPROXIMATION. Lee, M.A.; Lerche, I. (Enrico Fermi Institute, University of Chicago). Astrophys. J. 194: No. 2, 409-417 (1 Dec 1974).

In this paper we illustrate how the presence of a high intensity pulse of radiation can distort its own passage through a plane differentially shearing medium. We demonstrate that the distortion is a sensitive function of the precise, and detailed, variation of the medium's refractive index by considering a couple of simple examples which we work out numerically. In view of the high-intensity pulses observed from pulsars (~10^{30} ergs per pulse), we believe that the present calculations are of more than academic interest in helping unravel the fundamental properties of pulse production in, and propagation through, differentially sheared media—such as pulsars' magnetospheres within the so-called speed-of-light circle. (auth)

23631 ON THE PASSAGE OF RADIATION THROUGH INHOMOGENEOUS, MOVING MEDIA. X. RAY AND PHASE PATHS IN ARBITRARY VELOCITY FIELDS. Lerche, I. (Enrico Fermi Institute and Department of Physics, University of Chicago). Astrophys. J. 194: No. 2, 403-408 (1 Dec 1974).

In this paper we develop the equations describing general phase and ray paths, seen by an inertial observer, when the medium through which the radiation is propagating is, in general, expanding, accelerating, and shearing. Further, the refractive index of the medium may be an arbitrary function of frequency, position, and local acceleration. Several models developed to account for the radiation observed from pulsars make use, either implicitly or explicitly, of media which are rapidly moving, rapidly accelerating, rapidly expanding, and/or highly sheared. Therefore, we believe that the general equations developed here may be of use in such models in helping to unravel the tangled skein of paths followed by radiation produced in and/or propagating through such media. (auth)

23632 THE GAMMA CYGNI SUPERNOVA REMNANT AND NEBULA. Johnson, H.M. (Lockheed Missiles and Space Company). Astrophys. J. 194: No. 2, 337-342 (1 Dec 1974).

The object is anomalous, and the existing data appear to be rather contradictory or ambiguous. We discuss previous and new observations. The new observations are: Palomar Schmidt plates in the blue, yellow, red, and near-infrared; radiofrequency-continuum maps at 7.875 and 15.5 GHz; flux densities at 31.4 and 85 GHz; and H 94α-line data. A nebula, found only in the red, is identifiable with a small component of a supernova remnant which is altogether about 1° in diameter. The spectral index of the large, nonthermal remnant is prevalently about −0.8, but the index is probably ⩾ −0.5 in the small component. The amorphous structure of the red nebula suggests that its light is nonthermal, since it is not a reflection nebula of the star γ Cygni. Optical spectroscopy and microwave recombination-line mapping in high spatial resolution are needed for further information. (auth)

23633 X-RAY STRUCTURE OF THE CYGNUS LOOP. Rappaport, S.; Doxsey, R.; Solinger, A. (Physics Department, Massachusetts Institute of Technology); Borken, R. Astrophys. J. 194: No. 2, 329-335 (1 Dec 1974).

An X-ray surface brightness map of the Cygnus Loop in the energy range 0.15-0.85 keV is presented. The X-ray distribution is compared with the optical and radio pictures of the Loop. The location of the center of the supernova shell as derived from the X-ray data is α (1950) = $20^h49^m45^s$, δ (1950) = 30°53′, which is in excellent agreement with the apparent optical and radio centers. We obtain a mean diameter for the X-ray shell of 2.°75±0.°2. The X-ray spectral data yield a characteristic thermal temperature averaged over the Loop of T_e = $2.9\pm1.5\times10^6$°K. We have calculated anew X-ray parameters for adiabatic blast waves using X-ray production spectra which include line radiation. These parameters are compared with the results of the present experiment. An age of 18,000 years, initial blast energy equal to 3×10^{50} ergs, and ambient interstellar density of 0.25 cm^{-3} are found. (auth)

23634 SPECTROPHOTOMETRY OF THE CRAB NEBULA. Kirshner, R.P. (Hale Observatories, California Institute of Technology). Astrophys. J. 194: No. 2, 323-327 (1 Dec 1974).

The entire Crab Nebula has been observed in 23 bands from 3400 to 7800 Å, to establish the continuum shape and emission-line fluxes. The optical continuum resembles a power law $f_\nu = C_\nu^{-0.4}$ if A_v is 1.6 mag. The observed Hβ flux corresponds to 0.4 $M_\odot$ of ionized hydrogen, for the same interstellar absorption, if $N_e = 10^3$ and T_e = 15,000°K. The line flux ratios without correction for reddening, are [O II] λ3727/Hβ = 8 ± 2, [O III] λ4959/Hβ = 4 ± 1, [O III] λ5007/Hβ = 11 ± 3, Hα + [N II]/Hβ = 18 + 4, and [S II] λ6717 + λ6731/Hβ = 10±3. (auth)

23635 FINE STRUCTURE IN H II REGIONS II. Turner, B.E.; Balick, B. (National Radio Astronomy Observatory, Charlottesville, Virginia); Cudaback, D.D.; Heiles, C.; Boyle, R.J. Astrophys. J. 194: No. 2, 279-291 (1 Dec 1974).

Interferometric synthesis of the continuum emission at 11 cm wavelength has been performed for several galactic H II regions which lie near sources of OH and H_2O emission. The spatial resolution is between 4.°9 and 17.°2 in the narrowest direction. Fine structure with scales sizes of order 0.1 pc are observed in some cases, where intermediate (~3 pc) or no small structure is found in others. The relationship of the continuum structure to the distribution of molecules such as CO, CS, HCN, to the positions of OH and H_2O emission, and to preliminary maps in the infrared is discussed. A qualitative picture which is consistent with these relationships is discussed. (auth)

23636 THE LINEAR POLARIZATION OF QUASI-STELLAR RADIO SOURCES AT 3.71 AND 11.1 CENTIMETERS. Wardle, J.F.C. (Department of Physics, Brandeis University); Kronberg, P.P. Astrophys. J. 194: No. 2, 249-255 (1 Dec 1974).

Accurate measurements of the integrated linear polarization of 94 quasars at λ=11.1 cm and 79 quasars at λ=3.71 cm are presented. The observations were made with an interferometer in order to reduce the effects of confusion and ground radiation. The results are discussed briefly and a detailed discussion will be given elsewhere. It is found that nearly all sources showing negative depolarization also have flat spectra. The most strongly polarized sources (especially at 3.7 cm) tend to be steep-spectrum and high-luminosity objects. (auth)

23637 PULSAR HYDROGEN LINE ABSORPTION AND THE ELECTRON DENSITY IN THE INTERSTELLAR MEDIUM. Gomez-Gonzalez, J.; Guelin, M. (Observatoire de Paris, Section de Meudon, 92 (France). Dept. de Radioastronomie). Astron. Astrophys.; 32: No. 4, 441-446(Jun 1974).

Nine new pulsars have been observed for 21-cm line absorption. Distance limits have been derived for six of them. The new distances, together with previous pulsar data, are used for an analysis of the electron distribution in the interstellar medium. The electron density, averaged over a few kiloparsec path close to the galactic plane, is found to be uniform and is 0.03 cm^{-3}. (auth)

23638 CAN OH-SOURCES BE CHEMICAL MASERS. Kegel, W. H. (Univ., Heidelberg). Astron. Astrophys.; 32: No. 2, 227-228(May 1974).

It is discussed to which extent the population densities N_m and N_n of the maser levels in OH-sources are determined by the chemical reactions by which the molecules are formed. Since the 18 cm OH emission is due to transitions in the ground state Λ-doublet, it is concluded—assuming stationarity—that the processes that depopulate the lower maser level are more important than those by which the molecules are formed. (auth)

23639 OPTICAL IDENTIFICATIONS AND RADIO SPECTRA OF THE DEEP NRAO 5 GHz SURVEY SOURCES IN THE B2 SURVEY AREA. Fanti, R.; Ficarra, A.; Formiggini, L.; Gioia, I.; Padrielli, L. (Univ., Bologna). Astron. Astrophys.; 32: No. 2, 155-160(May 1974).

Optical identifications are given with galaxies and blue objects of a survey of faint sources made with the NRAO 300-ft. telescope at 5 GHz. The comparison between the spectral indices distribution of the sources of this sample and the distribution of strong sources at the same frequency shows a dependence of the mean spectral index on the flux density. In particular to decreasing fluxes corresponds a lower percentage of sources with flat spectra ($\alpha < 0.5$). The percentage found for sources stronger than 0.6 f.u., 51%, decreases down to 34% for sources stronger than 0.067 f.u. Moreover the comparison of the spectral index distribution of the quasars of the sample with the distirbution of strong sources shows that the most conspicuous part of the flat spectra percentage variation with flux seems due to quasars. The M. Schmidt evolution model for quasars describes reasonably well the results. (auth)

23640 VARIATIONS OF THE OPTICAL EMISSION-LINE SPECTRUM OF THE ECLIPSING BINARY X-RAY STAR HD 153919 (=2 U 1700-37). Dachs, J.; Schober, H. J. (Bochum Univ. (F. R. Germany). Astronomisches Inst.). Astron. Astrophys.; 33: No. 1, 49-54(Jun 1974).

The strengths of several emission lines in the spectrum of the Of-type star HD 153919, which is the occulting body of the eclipsing X-ray source 2U 1700-37, have been studied for periodic variations with a photoelectric spectrum scanner at a resolution of 10 A. No regular variations with phase exceeding the mean error of the measurements (about 10%) are found for the strength of the emission lines of N III (4634/4641 A) + C III (4650 A) and of He II (4684 A). From ten measurements of the equivalent width of the Hα emission line, a periodic variation is indicated with a maximum at or shortly after the center of the occultation of the X-ray source by the Of star. These results confirm earlier conclusions of Hutchings (1968) that the Hα emission in Of-type stars is produced in an expanding envelope which is much more extended than the layers emitting the N III, C III and He II (4686 A) lines. (GE)

23641 TIME DELAYS FOR MULTIPLY IMAGED QUASARS. Cooke, J.H. (The University of Texas at Arlington); Kantowski, R. Astrophys. J. Lett. 195: No. 1, L11-L14 (1 Jan 1975).

We present a general expression for the difference in arrival times of light signals which originate simultaneously at a cosmologically distant source but which travel along different paths due to an intervening gravitational lens. The time delay consists of two terms: the first due to the difference in geometrical paths lengths and the second is due to the difference in the gravitational potential through which the two light rays travel. We conclude that the potential term is significant and cannot be neglected. (auth)

23642 RADIO SPECTRA AND RED SHIFTS OF 179 QSOs. Kraus, J.D.; Gearhart, M.R. (Ohio State University Radio Observatory, Columbus, Ohio). Astron. J. 80: No. 1, 1-8 (Jan 1975).

A comparison is made between radio spectral type and red shift for all known QSOs having adequate radio and optical data. A ratio of CE (centimeter excess) to N (normal) spectrum sources is defined and its variation with red shift is given. A radio color–color versus red shift diagram for the 179 QSOs is also presented. The CE/N excess is found to increase rapidly for $z > 2$ and the significance of this trend is discussed. (auth)

23643 PHOTOELECTRIC OBSERVATIONS OF CENTAURUS X-3. Mauder, H. (Astronomisches Institut der Universität Tübingen). Astrophys. J. Lett. 195: No. 1, L27-L30 (1 Jan 1975).

Photoelectric observations in the V band have yielded a light curve for the optical counterpart of Cen X-3. The amplitude of the light variations is 0.14 mag, which rules out the possibility of a very low mass ratio. It is shown that the X-ray source, which is believed to be a neutron star, must have a lower mass limit close to 3 $M_\odot$. The photometric properties indicate a distance of about 7 kpc. Besides a double wave due to the tidal distortion of the star, the light variations also show some intrinsic activity on a time scale of fractions of a minute. A radial velocity variation with an amplitude of 60 km s^{-1} is predicted. (auth)

23644 A SEARCH FOR OPTICAL PULSATIONS FROM CENTAURUS X-3. Peterson, B.A. (Mount Stromlo and Siding Spring Observatory, Research School of Physical Sciences, Australian National University); Middleditch, J.; Nelson, J. Astrophys. J. Lett. 195: No. 1, L31-L32 (1 Jan 1975).

No optical pulses were detected from Cen X-3 at the 0.2 percent level. The observations were made during the binary phase expected to produce optical pulses of the greatest amplitude. (auth)

23645 OPTICAL STUDIES OF UHURU SOURCES. XI. A PROBABLE PERIOD FOR SCORPIUS X-1=V818 SCORPII. Gottlieb, E.W.; Wright, E.L.; Liller, W. (Center for Astrophysics, Harvard College Observatory and Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 195: No. 1, L33-L35 (1 Jan 1975).

1068 magnitudes of Sco X-1=3U 1617-15=V818 Sco have been obtained from blue plates in the Harvard collection taken between 1889.5 and 1974.3. We have analyzed these data for periods from 0.25 to 100 days; the best period found, $0^d.787313 \pm 0^d.000001$, gives a sinusoidal light curve with full amplitude of 0.22 ± 0.03 mag. This period is confirmed by published postdiscovery photometry. (auth)

23646 SYNCHROTRON SPECTRA OF NONUNIFORM COMPACT SOURCES. Condon, J. J. (National Radio Astronomy Observatory, Charlottesville, VA); Dressel, L. L. Astrophys. Lett.; 15: No. 4, 203-207(Dec 1973).

The effects of a radially dependent magnetic field and particle density on synchrotron self-absorbed source spectra are computed. It is shown that the principal consequence of decreasing the field or particle density away from the center is a broadening of the low-frequency side of the spectral peak, which strongly smooths the spectra of sources containing such tapered components. Sources in which these quantities increase toward the outside (blast wave sources) have spectra almost indistinguishable from those of uniform density sources. The relation between spectral complexity and radio variability is discussed in terms of component structure. (auth)

23647 CAUSE OF THE MAXIMUM INTENSITY OF THE 1665-MHz RADIO LINE IN THE OH MASER SOURCES ASSOCIATED WITH H II REGIONS. Burdjuzha, V. V. (Inst. for Space Research, Moscow). Astrophys. Lett.; 15: No. 4, 189-192(Dec 1973).

A possible cause leading to the maximum intensity in the 1665-MHz radio line in the OH maser sources associated with H II regions, is the conservation of a resonant line in the far-infrared spectrum distorted after the passage of a certain optical depth. This line, together with the infrared cascade, provides a population transfer from the inverted $F = 2^+$ level to the inverted $F = 1^+$ level of the rotational ground state of the OH molecule. An observational test is proposed. (auth)

23648 NEW SEARCH METHOD FOR PULSARS. Hamilton, P. A. (Univ. of Tasmania, Hobart, Australia); McCulloch, P. M.; Ables, J. G.; Komesaroff, M. M.; Cooke, D. J. Astrophys. Lett.; 15: No. 4, 163-167(Dec 1973).

A new method of pulsar searching is presented, which permits the use of large effective instrumental bandwidth without an accompanying loss of sensitivity to sources with short periods or high dispersion measures. (auth)

23649 RESULTS AND IMPLICATIONS OF A RECENT SEARCH FOR HIGH-DISPENSION PULSARS. Komesaroff, M. M. (CSIRO, Sydney); Ables, J. G.; Cooke, D. J.; Hamilton, P. A.; McCulloch, P. M. Astrophys. Lett.; 15: No. 4, 169-174(Dec 1973).

A strip along the galactic plane extending over $300° \lesssim l \lesssim 365°$ and $|b| \lesssim 1.5°$ was searched for pulsars by a new technique which partly overcomes dispersion. Eight new pulsars were found, four having dispersion measures greater than 250 cm^{-3} pc; of these four, three show measurable scattering at 750 MHz. Included among these is a pulsar having the highest intrinsic intensity and largest dispersion measure yet recorded. This pulsar is within 30 arc min of a strong x-ray source with an unusual spectrum, and close to a recently discovered supernova remnant. (auth)

23650 CRAB PULSAR: PRECURSOR PULSE DETECTION AT 606 MHz. Boriakoff, V.; Payne, R. R. (National Astronomy and Ionosphere Center, Arecibo, Puerto Rico). Astrophys. Lett.; 15: No. 4, 175-176(Dec 1973).

The supposed disappearance of the precursor pulse of the Crab

pulsar at 606 MHz as quoted by Rankin et al. is shown to be only a decrease in intensity. Spectral indexes for the total pulse and its different components are measured on the basis of 430 MHz and 606 MHz observations, and evidence is presented for a spectral index change with frequency. (auth)

Solar Phenomena

23651 THE RECORDS OF SOLAR WIND AND SOLAR FLARES IN AUBRITES. Poupeau, G. (Museum National d'Histoire Naturelle, 75 – Paris (France). Lab. de Mineralogie); Kirsten, T.; Steinbrunn, F.; Storzer, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Earth Planet. Sci. Lett.; 24: No. 2, 229-241(Dec 1974).

A large number of individual enstatite crystals of the gas-rich aubrites Khor Temiki, Staroe Pesyanoe and Bustee was analyzed for implanted helium and for steep gradient ion tracks in order to investigate the relation between solar flare irradiation and solar wind implantation with extreme local resolution. Irradiated and nonirradiated crystals coexist within the gas-rich phases of the aubrites investigated. Statistically in a given meteorite the proportion of crystals with implanted solar wind is similar to the proportion of solar flare irradiated crystals. It varies from aubrite to aubrite in the sequence of their bulk contents of trapped rare gases. For nine enstatites, tracks and rare gases were subsequently measured within the same crystal. The results support the intimate association of solar flare tracks and implanted He. The ^{4}He-surface concentrations of irradiated crystals vary between $<5 \times 10^{-7}$ and 10^{-4} cm^3 STP/cm^2. The absence of saturation effects together with the low degree of elemental gas fractionation indicates very short solar wind exposure times (<100 yr) rather than strong diffusion losses. The evidence from tracks and rare gases can be understood in terms of an early simultaneous irradiation of aubritic crystals by solar wind and solar flare particles on top of a regolith-covered parent body. (auth)

23652 ANALYSIS OF EXTRATERRESTRIAL MATERIALS. Proceedings of a Symposium Held at Vienna, Austria, October 2–3, 1973. Kiesl, W.; Malissa, H. Jr. (eds.). Vienna; Springer-Verlag (1974). 336p. (In German and English). $21.60.

Topics discussed demonstrate the important role of analytical chemistry in explaining extraterrestrial phenomena and include studies of noble gases in lunar samples, a determination of the noble gas components of the solar wind, the determination of chemically bound nitrogen in lunar material, analyses of carbon 14 in lunar rock, isotope anomalies in lunar samples, the significance of trace elements in cosmochemical events and their determination in lunar and meteoritic samples, the use of neutron activation analysis to determine trace elements in meteorites and chondrites, a group of correlated elements in lunar samples, the detection and origin of organic molecules in interstellar space, element abundances in peculiar A stars, the use of microchemical methods in meteorite research, the use of spinels as indicators of variations in the chemical composition of the Moon, computer evaluation of x-ray diffraction data regarding meteoritic samples, and the structure of the matrix and inclusions of the Landes meteorite. (IAA)

23653 GEOPHYSICAL CONSEQUENCES OF THE SOLAR FLARES OF AUGUST 1972 ACCORDING TO OBSERVATIONS OF THE SVERDLOVSK OBSERVATORY. Bulashevich, Yu. P.; Ayubasheva, S. I.; Ivanov, N. A.; Utkin, V. I.; Shapiro, V. A. (Inst. of Geophysics, Sverdlovsk, USSR). Dokl. Akad. Nauk SSSR; 216: No. 3, 528-531(21 Mar 1974). (In Russian).

Changes in the geomagnetic field, ionospheric parameters, and intensity of cosmic radiation as a result of the solar flares of August 1972, measured at the Sverdlovsk observatory, are reported. (JSR)

23654 EXTREME ULTRAVIOLET EMISSION SPECTRUM OF FE XIII. Flower, D. R. (Observatoire, Meudon, France); Nussbaumer, H. Astron. Astrophys.; 31: No. 3, 353-360(Mar 1974).

The comparison of the observed and calculated intensities of the ultraviolet emission lines of Fe XIII in the 200 to 300 Å range enables the electron density of the emitting region to be determined. The observed intensities date from a rocket flight on April 4, 1969. Consistent values of the electron density are derived from both the relative and the absolute line intensities. The necessary atomic data, principally radiative transition probabilities and electron collision cross-sections, have been calculated with full allowance for configuration interaction. The results of these atomic physics calculations are tabulated. Also presented are the computed intensities of the strongest emission lines of Fe XIII in the 200 to 400 Å range, which may serve for similar analyses of future observational data. (auth)

23655 BROADBAND POLARIZATION MEASUREMENTS ON THE QUIET SUN'S DISK NEAR LAMBDA 5834. Mickey, D. L.; Orrall, F. Q. (Univ. of Hawaii, Honolulu). Astron. Astrophys.; 31: No. 2, 179-183(Mar 1974).

The complete state of polarization of radiation from the quiet sun's disk was measured as a function of distance from the limb in a 20Å wide wavelength band centered at λ 5834—a region relatively free of Fraunhofer lines. These measurements were made using a polarimeter-photometer at Mt. Haleakala (Orrall, 1971). The results are very consistent with the linear polarization measurements of Leroy (1972), but are new in that: (1) they are of higher spatial resolution; (2) they extend to the extreme limb; (3) all four Stokes parameters of the radiation have been measured; and (4) because the intensity is measured simultaneously with the polarization, the distance from the limb can be inferred with high precision. There is no evidence in this data for circular polarization on the quiet disk that varies systematically with distance from the limb. The measured values of the linear polarization are in excellent agreement with the theoretical values calculated for this same wavelength region by Dêbarbat et al. (1970a, b) and Dumont and Pecker (1971) at $\mu = 0.2$ and 0.4. However their calculated value at $\mu = 0.1$ is significantly lower than the observed value. (auth)

23656 SUPPORT OF PROMINENCES FORMED IN NEUTRAL SHEETS. Kuperus, M.; Raadu, M. A. (Univ., Utrecht). Astron. Astrophys.; 31: No. 2, 189-193(Mar 1974).

It is shown that prominence filaments formed in a magnetically neutral sheet in the corona can be supported against gravity by magnetic forces due to induced currents in the photospheric boundary. The supporting force is inversely proportional to the height above the photosphere and the filaments seem stable against small perturbations. The adopted magnetic field configuration allows for a prominence eruption. However, it is suggested that the so-called disparition brusque may only occur if either the prominence loses weight by mass loss or through the influence of large scale changes in the photospheric magnetic field. (auth)

23657 SIMULTANEOUS DETERMINATION OF 20 TRACE ELEMENTS IN TERRESTRIAL, LUNAR, AND METEORITIC MATERIAL BY RADIOCHEMICAL NEUTRON ACTIVATION ANALYSIS. Keays, R. R.; Ganapathy, R.; Laul, J. C.; Kraehenbuehl, U.; Morgan, J. W. (Univ. of Chicago). Anal. Chim. Acta; 72: No. 1, 1-29(Sep 1974).

A radiochemical neutron activation method has been developed and was applied to the determination of Ag, Au, Bi, Br, Cd, Cs, Cu, Ga, Ge, In, Ir, Ni, Rb, Re, Sb, Te, Tl, U, and Zn in 45 terrestrial, 230 lunar, and 70 meteoritic samples. The inherent accuracy and precision for most elements is generally 10% or better, as is demonstrated by the results for well-mixed powdered rocks, for example, the U.S.G.S. standard basalt BCR-1. (NL)

23658 HIGH RESOLUTION INTERFEROMETRIC OBSERVATIONS OF ACTIVE REGIONS AT 2.8 CM. I. Equatorial Brightness Distribution. Falchi, A.; Felli, M.; Tofani, G. (Osservatorio Astrofisico, Arcetri, Italy). pp 105-112 of Fourth Meeting of the Committee of European Solar Radio Astronomers. Schanda, E. (ed.). Meudon, France; Observatoire de Paris (1974).

From 4th conference of the Committee of European Solar Radio Astronomers; Bern, Switzerland (4 Mar 1974).

The brightness distribution over an equatorial strip of the Sun was obtained by joining together several one-dimensional synthesis observations. The derived plots provide information on the position, shape, and long-term evolution of active centers at 2.8 cm. (auth)

23659 SOLAR FLARES. Michard, R. (Observatoire de Paris, Meudon, France). Recherche (Paris); 5: No. 47, 616-633(Jul 1974). (In French).

Measurements carried out on either hydrogen Hα rays or high-energy solar particles ejected during solar flares are used to propose models of these phenomena in which the magnetic field plays a major part. (FR)

23660 EARLY MANIFESTATIONS OF THE NEW CYCLE OF SOLAR ACTIVITY. Koutchmy, S.; Bareau, C.; Stellmacher, G. (CNRS, Paris). Compt. Rend., Ser. B; 278: No. 19, 873-876(6 May 1974). (In French).

The spectrum of the solar corona obtained during the Sun's eclipse of June 30, 1973 in Tchad exhibit forbidden lines of strongly ionized elements (Fe XIV, Ni XIII, Ni XVII, and Ar X) near the south pole. Both the presence of these lines, characterizing active solar regions and the morphology of the solar corona in this region tend to indicate that the new 11-year cycle of solar activity could be detected at least three years before it commences. This phenomenon should lead to a revision of existing solar activity models, the poles probably generating a current of matter (solar wind) of high velocity. (FR)

23661 CHEMICAL ASPECTS OF METEORITIC AND LUNAR MATERIAL. Mueller, O. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Chem.-Ztg., Chem. App.; 98: No. 6, 281-287(Jun 1974). (In German).

A short review of important chemical characteristics of meteoritic and lunar matter is presented. Especially, the classification of meteorites, the significance of chondritic stone meteorites being an original and for our solar system representative material, chemical fractionations of chondrites, the isotopic composition in meteorites and organic compounds in carbonaceous chondrites are discussed. The peculiar geochemical nature of lunar rocks, and elemental differences compared to terrestrial and meteoritic rocks are described. Investigations of implanted solar wind in lunar soils, and instrumentally performed geochemical experiments by the Apollo missions are discussed. Finally, hypotheses on the Moon's origin and the importance of Ca-Al-rich high temperature inclusions of the meteorite Allende are dealt with. (auth)

23662 SOLAR SURGES: MAGNETIC PROPERTIES, DYNAMICS, AND STRUCTURE. Roy, J. C. London, Ont.; Univ. of Western Ontario (1973). 221p.

Thesis.

This investigation is an attempt to determine the conditions under which sporadic mass ejections, called solar surges, occur in sunspot regions of the solar atmosphere. High-resolution (~0.3 arcsec) on- and off-band Hα filtergrams (passband of ¼ Å) of disk solar surges obtained with the Vacuum Tower Telescope of Sacramento Peak Observatory have been compared to magnetic data. (CA)

23663 APPLICATION OF MATRIX ANALYSIS IN THE STUDY OF SOLAR-TERRESTRIAL RELATIONSHIPS. Velinov, P. I. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 7, 917-919(1974).

The author previously proposed to introduce matrix analysis into the study of Sun-Earth relationships, its elements representing the partial frequencies of the corresponding solar-terrestrial effects. In this paper the matrix method is applied to the study of the relation between the course of the relative number of sunspots and some processes in interplanetary space. (WDM)

23664 ANALYSIS OF SOLAR GRANULATION USING LASER-LIGHT. Schlosser, W.; Klinkmann, W. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 32: No. 1, 29-37(Apr 1974). (In German).

Laseroptical analysis of photographs of solar granulation fields gives both qualitative and quantitative information on basic parameters of the granulation in a quick and convenient manner. The general approach is to analyze the Fourier-transform of the granulation pattern. This is achieved by illuminating slides of granulation fields with slightly converging laser-light. The resulting diffraction in the focal-plane is the square of the Fourier-transform of the intensity distribution in the slide. (WDM)

23665 POLARIZATION FINE STRUCTURE IN SOLAR RADIOBURSTS OF TYPE III ON SHORT METER WAVELENGTHS. Slottje, C. (Netherlands Foundation for Radioastronomy, Dwingeloo). Astron. Astrophys.; 32: No. 1, 107-110(Apr 1974).

Accurately calibrated measurements with the 60-Channels Solar Radiospectrograph, now operated at Dwingeloo between 315 and 200 MHz, led to the discovery of fine structure in the time profile of the degree of polarization of some Type III bursts: after a short peak of very high values the polarization drops to about 10% while the intensity increases to its maximum. This behavior is in agreement with a model given by Fomichev and Chertok. A more sophisticated model enables to deduce from the observed polarization profile and frequency drift rate, consistent values for the magnetic field strength in the source, the density gradient of the ambient plasma and the exciter speed. As the model predicts a different polarization profile for fundamental and harmonic radiation respectively the bursts of the present case are identified as fundamental radiation. (auth)

23666 ANALYSIS OF THE SOLAR MAGNESIUM I SPECTRUM. Altrock, R.C.; Canfield, R.C. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, New Mexico). Astrophys. J. 194: No. 3, 733-741 (15 Dec 1974).

Without assuming local thermodynamic equilibrium (LTE), we simultaneously solve the equations of statistical equilibrium and radiative transfer for a model Mg I atom that includes the lines λλ4571, 5172 (b_2), and 2852, which we then compare with observations. From this comparison we determine by trial and error an optimum model of $T_e(h)$, $N_e(h)$, $N_H(h)$, and microturbulent velocity in the solar atmosphere up to approximately h=1000 km. In addition, we show that the assumption of LTE for the λ4571 source function is valid to a high degree of precision. (auth)

23667 SOLAR NEUTRINOS AND THE INFLUENCE OF RADIATIVE OPACITIES ON SOLAR MODELS. Carson, T.R.; Ezer, D.; Stothers, R. (Institute for Space Studies, Goddard Space Flight Center, NASA). Astrophys. J. 194: No. 3, 743-744 (15 Dec 1974).

Use of new radiative opacities based on the hot Thomas-Fermi model of the atom yields a predicted solar neutrino flux which is still considerably larger than the flux observed in Davis's ^{37}Cl experiment. (auth)

23668 THE $^{12}C/^{13}c$ RATIO IN COMET KOHOUTEK (1973f). Danks, A.C.; Lambert, D.L. (McDonald Observatory and Department of Astronomy, University of Texas, Austin); Arpigny, C. Astrophys. J. 194: No. 3, 745-751 (15 Dec 1974).

Photoelectric scans of the C_2 1-0 band head at 4737 Å in comet Kohoutek (1973f) are presented at resolutions of 0.14-0.5 Å. Two values are derived for the $^{12}C/^{13}C$ ratio (115[+30,-20] and 135[65,-45]), and these are consistent to within the experimental errors with the terrestrial ratio $^{12}C/^{13}C=89$. (auth)

23669 THE IMPOSSIBILITY OF PLASMA RADIATION FROM ELECTRON PLASMA WAVE TURBULENCE WITHIN COLLISIONLESS SHOCK WAVES. Smith, D.F. (High Altitude Observatory, National Center for Atmospheric Research); Krall, N.A. Astrophys. J. Lett. 194: No. 3, L163-L165 (15 Dec 1974).

An argument using many simplifying assumptions was given by Stepanov on why plasma radiation from electron plasma waves within a laminar perpendicular collisionless MHD shock wave would be suppressed. Here we show without any assumptions that such radiation is not only suppressed, but impossible regardless of whether the waves are excited. As a result a whole class of theories for plasma radiation from laminar perpendicular collisionless shock waves, some of which have been applied to the interpretation of type II solar radio bursts become completely untenable. (auth)

23670 NON-LTE H_2^+ AS THE SOURCE OF MISSING OPACITY IN THE SOLAR ATMOSPHERE. Swamy, K.S.K.; Stecher, T.P. (Goddard Space Flight Center, Greenbelt, Maryland). Astrophys. J. Lett. 194: No. 3, L153-L156 (15 Dec 1974).

The population of the various vibrational levels of the H_2^+ molecule has been calculated from the consideration of formation and destruction mechanisms. The resulting population is used in calculating the total absorption due to H_2^+ and is compared with the other known sources of opacity at several optical depths of the solar atmosphere. It is shown that the absorption due to H_2^+ can probably account for the missing ultraviolet opacity in the solar atmosphere. (auth)

23671 RIGID AND DIFFERENTIAL ROTATION DRIVEN BY OSCILLATIONS WITHIN THE SUN. Wolff, C.L. (Laboratory for Solar Physics and Astrophysics, NASA-Goddard Space Flight Center). Astrophys. J. 194: No. 2, 489-498 (1 Dec 1974).

Long-period oscillations involving the entire mass of the Sun rotate like rigid bodies and their oscillatory power is distributed nonuniformly across the solar surface. A mostly qualitative theory is constructed of how the oscillations drive convective flows of global scale which then organize photospheric and coronal magnetic fields into patterns which rotate rigidly. The convection rises along long graceful curves creating the magnetic-arcade structures in the corona and unipolar photospheric regions on each side by dynamo action. These are thought to be the origin of the sector structure in the solar wind. The rigid patterns of convective upwelling also force nonrigid horizontal winds on the solar surface. Under the action of the Coriolis force, the main horizontal motions are converted into polar and equatorial wind currents which have the proper directions to drive the differential rotation long observed on the Sun's surface. (auth)

23672 A SIMPLIFIED METHOD FOR CALCULATION OF RADIATIVE ENERGY LOSS DUE TO SPECTRAL LINES. Canfield, R.C. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, New Mexico). Astrophys. J. 194: No. 2, 483-488 (1 Dec 1974).

In problems of atmospheric structure, numerical complexity often precludes exact treatment of the radiative transfer problem, making approximate methods necessary. Such a method, outlined here, permits one to estimate radiative losses in spectral lines in atmospheres of nonnegligible optical depth. The technique uses approximate solutions of the transfer equation to obtain source functions and photon escape probabilities as a function of position in the atmosphere. We outline the method and give an example of its application to hydrogen excitation, ionization, and radiative losses in a solar flare model. The results are then compared with an exact calculation. The method reduces computing time by over four orders of magnitude. (auth)

23673 RELATIVE CORONAL ABUNDANCES DERIVED FROM X-RAY OBSERVATIONS. III. THE EFFECT OF CASCADES ON THE RELATIVE INTENSITY OF Fe XIII LINE FLUXES, AND A REVISED IRON ABUNDANCE. Walker, A.B.C. Jr. (Institute for Plasma Research, and Department of Applied Physics, Stanford University;); Rugge, H.R.; Weiss, K. Astrophys. J. 194: No. 2, 471-482 (1 Dec 1974).

Observations of the helium–like and hydrogen–like resonance lines of N, O, Ne, Na, Mg, Al, Si, S, and Ar below 25 Å, made from the U.S. Air Force satellites OVI–10 and OVI–17, have previously been used to construct coronal models and to determine the relative abundances of these elements. Lines of Fe XVII are also prominent in the coronal spectrum below 25 Å. The intensities of the lines of the 2p–3d transitions near 15 Å have also been used in conjunction with these coronal models, and the assumption that the excited states are populated only by collisional excitation from the ground state ("coronal excitation"), to determine the Fe abundance. We have observed eight lines of Fe XVII which originated from the $2p^5 3s$, $2p^5 3d$, and $2s2p^6 3d$ configurations in the coronal spectrum between 13 and 18 Å. Many of the upper levels are populated by cascade so that the assumption of "coronal excitation" is not a valid one for most of these lines. Recent theoretical work on the spectrum of Fe xvii has taken account of the statistical equilibrium of the first 36 excited states in computing the intensities of the observed lines. Although the theoretical atomic rate constants for Fe XVII (especially the collisional excitation rates) cannot be as accurately calculated as those of the simpler ions, the relative intensities of the 2p–3d Fe XVII lines observed in the corona are now in good agreement with theoretical predictions. The measured flux in the lines from the $2s^22p^53s$ levels, which are populated in part by cascade from the $2p^63l$ (l = 1,2,3) levels, have been used to obtain the excitation–rate coefficients for the $2s2p^63l^3L$ levels, since the theoretical rate coefficients for these excitations are less accurately known than those for the 2p–3l transitions. Using this more complete theoretical model, and higher–resolution observations which allow a number of line blends to be resolved, we have revised our earlier calculation of the coronal abundance of Fe. We find an iron abundance relative to hydrogen of 26×10^{-6}, which is in excellent agreement with the photospheric iron abundance. (auth)

23674 TRANSVERSE PLASMA WAVES IN THE SOLAR WIND CLOSE TO THE PROTON GYROFREQUENCY. Rehn, H. W. (Technische Univ. Braunschweig (F. R. Germany). Inst. fuer Geophysik und Meteorologie). Z. Geophys.; 40: No. 3, 269-282(1974).

Transverse right-hand-polarized waves propagating along a magnetic field in the hot plasma of the solar wind consisting of protons and electrons are discussed for frequencies in the vicinity of the proton gyrofrequency. The thermal anisotropies of the particles are able to produce a nonresonant and a resonant instability. The first one, called firehose instability, is driven by electrons and protons, while the extension of this instability is produced by the electrons only. The second one, called cyclotron instability, is maintained by the protons. The same is true for the extension of this instability. Two different approximations of the dispersion relation allow the analytic discussion of the firehose and the cyclotron instability. (GE)

23675 DEPOLARIZATION CROSS-SECTIONS OF Fe^{13+} IN COLLISION WITH PROTONS. Maxnou-Seeuws, F. (Observatoire de Meudon, France). Astron. Astrophys.; 32: No. 2, 229-230(May 1974).

Cross-sections are computed for transitions between Zeeman sublevels in the ground state of Fe^{13+} colliding with protons. A semi-classical method is used as in the earlier work of Masnou-Seeuws and McCarroll (1972). The coupled equations are solved numerically without further approximation. The results can be useful for the study of depolarization of the green line $\lambda = 5303$ of the solar corona. (auth)

23676 ROLE OF COLLISIONS IN THE POLARIZATION RATE OF THE FORBIDDEN EMISSION LINE OF THE SOLAR CORONA. I. Depolarization by Proton Impact. Application to the Green Line of Fe XIV and to the Infrared Lines of Fe XIII. Sahal-Brechot, S. (Observatoire de Meudon, France). Astron. Astrophys.; 32: No. 2, 147-154(May 1974).

This paper is the first of a series devoted to detailed study of the role of collisions in determining the polarization rate of the intense forbidden lines of the solar corona. This first paper is restricted to the contribution of collisions with protons. The semi-classical perturbation theory with cut off is compared with the exact results of Masnou-Seeuws and McCarroll (1972) and is shown to be sufficient for calculations of fine structure cross sections of positive ions. Formulae are provided for calculating cross sections between Zeeman sublevels and the depolarization rates by proton impact of the green line of Fe XIV and of the infrared lines of Fe XIII are computed. (auth)

23677 LANDAU DAMPING OF TYPE III BURSTS BY THE INTERPLANETARY ELECTRONS OF HIGH ENERGY. Aubier, M. G. (Observatoire de Meudon, France). Astron. Astrophys.; 32: No. 2, 141-146(May 1974).

From the in situ measurements of electron flux the solar-wind electron velocity distribution at 1 AU was derived. This distribution is very different from a maxwellian, even during solar quietest times. The Landau damping was computed at 1 AU using this distribution and it is shown that the plasma waves of phase velocities $v_\phi \leqq 0.3$ c are Landau damped in $t_L \leqq 300$ s in the quiet solar-wind conditions and even faster ($t_L \leqq 20$ s) after a period of enhanced activity. It was concluded that the time profile of the bursts at 1 AU reflects the excitation of the plasma waves more than their damping. These results were extrapolated to regions closer to the Sun. The conclusions depend on the unknown variation of the high-energy tail of the electron distribution with distance from the Sun, but it is likely that due to this tail, the Landau damping is extremely efficient at altitudes above about $2R_\odot$. (auth)

23678 ON THE STRUCTURE OF THE QUIET CORONA NEAR QUIESCENT PROMINENCES. Fort, B.; Martres, M. J. (Observatoire de Paris, Section de Meudon, 92 (France)). Astron. Astrophys.; 33: No. 2, 249-255(Jul 1974).

Monochromatic images of the solar corona in the light of the red and green lines of Fe X and Fe XIV, respectively, obtained at the Pic-du-Midi Observatory, enable the geometrical structure of the quiet corona to be determined in the region of quiescent prominences, observed in Hα. The electron density of the emitting region is estimated from the results of a photometric analysis of the red and green line images. Some of the implications of the existence of "sheets of matter" in the quiet corona are discussed with particular reference to current ideas on coronal cavities. (GE)

23679 A SEARCH FOR DEUTERIUM ON THE SUN. Beckers, J.M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, New Mexico). Astrophys. J. Lett. 195: No. 1, L43-L45 (1 Jan 1975).

From observations of the Hα line of deuterium in quiescent solar prominences, I have determined a new upper limit to the solar D/H ratio of 2.5×10^{-7}. (auth)

23680 TIDAL FRICTION AND GENERALIZED CASSINI'S LAWS IN THE SOLAR SYSTEM. Ward, W.R. (Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91109). Astron. J. 80: No. 1, 64-70 (Jan 1975).

The tidal drift toward a generalized Cassini state of rotation of the spin axis of a planet or satellite in a precessing orbit is described. Generalized Cassini's laws are applied to several solar system objects and the location of their spin axes estimated. Of those considered only the Moon definitely occupies state 2 with the spin axis near to the normal of the invariable plane. Most objects appear to occupy state 1 with the spin axis near to the orbit normal. Iapetus could occupy either state depending on its oblateness. In addition, the resonant rotation of Mercury is found to have little effect on the tidal drift of its spin axis toward state 1. (auth)

23681 RUBIDIUM-87/STRONTIUM-87 AGE OF JUVINAS BASALTIC ACHONDRITE AND EARLY IGNEOUS ACTIVITY IN THE SOLAR SYSTEM. Allegre, C. J.; Birck, J. L.; Fourcade, S.; Semet, M. P. (Univ., Paris). Science; 187: No. 4175, 436-438 (7 Feb 1975).

A $(4.60 \pm 0.07) \times 10^9$ year internal isochron has been drawn for the achondrite Juvinas by the rubidium-87/strontium-87 method. Earlier petrographic investigation of achondrites supplemented by a new ion microprobe study of Juvinas strongly suggest an igneous origin for this class of meteorites. The results thus indicate that igneous activity may have rapidly followed the formation of the achondrites' parent body 4.6×10^9 years ago. (auth)

23682 SMALL-SCALE STRUCTURE IN SOLAR FLARING REGIONS OBSERVED AT WAVELENGTHS OF 3.71 AND 11.1 cm. Hobbs, R. W.; Jordan, S. D.; Maran, S. P.; Caulk, H. M.; Webster, W. J. Jr. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Lett.; 15: No. 4, 193-198(Dec 1973).

An extensive series of radio interferometric observations of the sun was made at wavelengths of 3.71 and 11.1 cm at Greenbank, West Virginia, during the period 31 October to 6 November 1972. The existence of small-diameter elements (as small as 2100 km) in flaring regions is established. The development of visibility elements during two flares is reported. (auth)

Galaxies

Refer also to abstracts 23637 and 23778.

23683 INTERSTELLAR MEDIUM. Proceedings of the Advanced Study Institute, Schliersee, Germany, April 2–13, 1973. Pinkau, K. (ed.). NATO Advanced Study Institute Series, Volume C6. Dordrecht, Netherlands; D. Reidel Publishing Company (1974). 305p. $25.90.

A collection of papers is presented concerning the composition

and properties of the interstellar medium, covering radio observations, visible and uv observations, and x-ray and gamma-ray astronomy. The subjects include H II regions, molecules in dense interstellar clouds, interstellar extinction, star formation and destruction, and the large-scale distribution of the interstellar medium in the Galaxy. Also discussed is the nucleosynthesis of light elements in the interstellar medium. (IAA)

23684 VERY HIGH VELOCITY CLOUD. Wright, M. C. H. (Univ. of California, Berkeley). Astron. Astrophys.; 31: No. 3, 317-322(Mar 1974).

λ 21 cm observations have revealed an H I cloud some 5° × 3° in angular extent in a direction towards l = 128°, b = −33° and at an LSR velocity of ~ −400 km s^{-1}. The cloud has a peak column density 4.2×10^{19} atoms cm^{-2} and a H I mass in excess of $200 \times (D[kpc])^2$ $M_\odot$. The appearance of the cloud and the velocity dispersions within a concentration are similar to those found in other high-velocity clouds and this cloud is discussed in terms of theories relating to the high-velocity cloud phenomenon. (auth)

23685 INTERFEROMETER STUDY OF H I ABSORPTION IN CENTAURUS A. Wright, M. C. H. (Univ. of California, Berkeley). Astron. Astrophys.; 31: No. 3, 283-287(Mar 1974).

Interferometer observations of the narrow H I absorption features around 560 km s^{-1} in the radio source Centaurus A (NGC 5128) have failed to reveal fine scale structure. Accordingly the absorption must be distributed over the radio emitting region in a phenomenon which may be similar to the high-latitude clouds in our Galaxy. The existence of a neutral hydrogen emission feature at 760 km s^{-1} is also confirmed. (auth)

23686 MOLECULES IN THE GALACTIC ENVIRONMENT. Conference Held at Green Bank, Virginia, November 4–7, 1971. Gordon, M. A.; Snyder, L. E. (ed.). New York; John Wiley and Sons, Inc. (1973). 489p. (CONF-711161-; ISBN-0-471-31608-3). $20.75.

Sessions were held on a review of the interstellar medium, observations of molecules, techniques of molecular spectroscopy, physics of molecular excitation, chemistry relevant to the astronomical environment, and possible biological relevance. (WDM)

23687 PLANETS, STARS, AND NEBULAE: STUDIED WITH PHOTOPOLARIMETRY. Conference Held at Tucson, Arizona, November 15–17, 1972. Gehrels, T. (ed.). Tucson, AZ; University of Arizona Press (1974). 1146p. (CONF-721145-; ISBN-8165-0428-8). $27.50.

Sessions were held on general theory and techniques, surfaces and molecules, and stars and nebulae. (WDM)

23688 RATIO OF TOTAL TO SELECTIVE EXTINCTION IN THE DIRECTIONS OF SELECTED PLANETARY NEBULAE. Lutz, J. H. (Washington State Univ., Pullman). pp 29-30 of Interstellar Dust and Related Topics. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973).

From proceedings of the symposium on interstellar dust and related topics; Albany, NY (29 May 1972).

23689 RECOMBINATION LINES NEAR 6-CM WAVELENGTH IN THE LARGE MAGELLANIC CLOUD. McGee, R. X.; Newton, L. M.; Brooks, J. W. (CSIRO, Epping, Australia). Aust. J. Phys.; 27: No. 5, 729-735(Oct 1974).

Recombination lines H 109α have been detected in eight sources in the Large Cloud of Magellan. Low ratios of line temperature to continuum temperature, T_L / T_C, were found in most of the sources and are attributed to the difficulty of obtaining a true continuum value when such a large area is encompassed by the telescope beam. In the 30 Doradus nebula the ratio $N(He^+)/N(H^+)$ was found to be no greater than 0.08, or less than half that previously recorded by radio observations. (auth)

23690 STUDIES OF IR II GALAXIES. II. NGC 3955 AND NGC 4433. Chromey, F. R. (Harvard Coll. Observatory, Cambridge, MA). Astron. Astrophys.; 31: No. 2, 165-177(Mar 1974).

Long-slit image-tube spectrograms of the Ir II galaxies NGC 4433 and NGC 3955 show that the ionized gas in both objects is of low density and excitation and must be executing large-scale noncircular motions. Dynamical models are presented which permit mass estimates for the inner portions of each galaxy (10.7 and 8.1×10^{10} $M_\odot$ for NGC 4433 and NGC 3955, respectively), as well as some estimate of the magnitude of the noncircular velocities (maximum of 100 to 200 km s^{-1} in both galaxies). Eleven-color intermediate-band photometry is combined with the spectroscopic data to derive emission and absorption line intensities, as well as estimates of the reddening internal to each galaxy. These measurements permit construction of synthetic stellar populations for each galaxy, which show that both objects contain appreciable numbers of young stars, but that NGC 3955 may be deficient in stars hotter than B 3. (auth)

23691 HIGH RESOLUTION MAP OF THE DISTRIBUTION OF NEUTRAL HYDROGEN IN THE SPIRAL GALAXY M 81. Rots, A. H. (Univ., Groningen, Netherlands); Shane, W. W. Astron. Astrophys.; 31: No. 2, 245-248(Mar 1974).

Preliminary results of H I line observations of M 81 with the Westerbork Synthesis Radio Telescope at 50″ resolution are presented. The distribution of neutral hydrogen column density forms a clear, simple spiral pattern, which in most places closely coincides with the optically luminous spiral arms of the galaxy. The radial distribution of H I shows a distinct minimum in the central region, while the maximum lies outside the region where the prominent optical spiral arms occur. Owing to missing information at interferometer baselines shorter than 36 m, large scale structures could not be detected and thus the zero level cannot be determined reliably. (auth)

23692 CENTRAL RADIO SOURCES IN THREE RICH CLUSTERS OF GALAXIES. Jaffe, W. (Leiden Observatory); Perola, G. C. Astron. Astrophys.; 31: No. 2, 223-234(Mar 1974).

Maps at 1415 MHz and 5 GHz obtained with the Westerbork Synthesis Radio Telescope of 5 C 4.81 and 5 C 4.85 (in the Coma Cluster), 3 C 338 (in Abell 2199) and 4 C 17.66 (in the Hercules Cluster) are presented. New results are: (1) 5 C 4.85 is resolved into a close double. (2) The tail of 5 C 4.81 has a width of less than 2 kpc in the first 20 kpc of its length. (3) 3 C 338 has an unresolved component associated with the nucleus of the most massive of the 4 galaxies in the NGC 6166 system. (4) The extended component of 3 C 338 is well resolved into an unusual double source. (5) 4 C 17.66, associated with NGC 6047, is resolved into an elongated object with relatively high linear polarization. The relationships between the observed properties of the radio sources and the physical conditions inside the clusters are discussed. The most important conclusions are that in two cases, 5 C 4.81 and 3 C 338, the radio source may be in pressure equilibrium with the surrounding gas, and that a consistent set of values for the internal magnetic field strength and the external density and temperature is obtained if: (1) the internal pressure is close to the minimum value corresponding to the equipartition magnetic field found when electrons and protons have equal energy densities and (2) the external pressure is that derived by interpreting the x-ray data on rich clusters as thermal bremsstrahlung from the intracluster gas. (auth)

23693 SOME PROBLEMS OF PARTICLE DYNAMICS WHICH ARE INTEGRATED ACCORDING TO STAECKEL'S THEOREM. Ivanov, Yu. I.; Kaisin, V. K. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 110-114(1972). (In Russian).

Some examples of the soluble problems of particle dynamics are considered. (auth)

23694 POLARIZATION OF EMISSION LINES IN THE DIFFUSE NEBULAE WITH SPECTRUM C + E. Rozhkovskii, D. A.; Dzhakusheva, K. G. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 72-78(1972). (In Russian).

Light scattering in the dusted Strömgren's zone is considered. In terms of the idealized model of the diffuse nebula with spectrum C + E, the polarimetric analysis of emission line H_α emitted by the periphery of the nebula is given. (auth)

23695 SPECTROPHOTOMETRIC SURVEY OF THE DIFFUSE GALACTIC NEBULAE. Glushkov, Yu. I.; Eroshevich, E. S.; Karyagina, Z. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 79-93(1972). (In Russian).

Spectra of 98 diffuse galactic nebulae in the 6200 to 7000 Å and 4500 to 5500 Å wavelength ranges were obtained. The observations were made with a grating spectrograph provided with an image converter. For some of these nebulae relative intensities of lines H_α/6584; 6717/6731; H_β/5007 and absolute intensities of the H_α line were found. These data characterize the radiation of the central part of the nebula of angular size about 1.0′ to 2.0′ to 7.5″. (auth)

23696 ABSOLUTE INTENSITY OF H_α-LINE IN THE SPECTRUM NEBULAE NGC 2068 AND S-57. Karyagina, Z. V.; Glushkov, Yu. I. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 94-97 (1972). (In Russian).

The absolute intensity (in erg cm^{-2} sec^{-1} · $sterd^{-1}$) of the H_α line in NGC 2068 and S-57 nebulae were obtained. The spectrophotometric standard in the investigation was the center of the Orion Nebula. (auth)

23697 THEORY OF OPEN SPIRALS. Genkin, I. L. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 17-23(1972). (In Russian).

Dynamics of wave propagation in an axisymmetrical nonin-

finitesimally thin disk is considered. It is shown that such waves can exist in the Lindblad's resonance region only, and that only arms having a logarithmic spiral form are stable in the radial direction. (auth)

23698 STABILITY OF THE OBLATE GALAXY. Chumak, O. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 24-30(1972). (In Russian).

In a first approximation the stability of the model, having fundamental properties of real stellar systems is considered. This model was found to be unstable in intermediate frequencies; in a limit cases necessary conditions of stability are fulfilled. (auth)

23699 ACTIVITY OF THE GALACTIC NUCLEUS. Idlis, G. M.; Semenenya, V. A. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 31-35(1972). (In Russian).

Taking into consideration the limitedness of material and energetic resources of the galactic nucleus, it is thought that the intense escape of hydrogen from the central zone, which is observed, is not constant and has a recurrent character. The results of the investigation show that the clouds of neutral hydrogen first revolving in the region around the center of the Galaxy along circular orbits might move to considerably stretched orbits as a result of a sufficiently powerful burst of the galactic nucleus, thence passing to the apogalaxy for 2 to 4 kps. Recurrently returning to the starting central zone with the radius of 1 to 2 kps, they have to leave it in a certain period of time (about 10^8 years), i.e., practically simultaneously having radial constituents of the orbital velocity of about 100 to 200 km/sec. (auth)

23700 CENTRAL PART OF COMA CLUSTER OF GALAXIES. III. Gainullina, R. Kh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 36-45(1972). (In Russian).

This article deals with the study of situations, flattenings, and position angles of 497 spheroidal galaxies ($a \geq 0.16$ mm) of the central part of Coma cluster ($r \leq 100'$). (auth)

23701 FREQUENCY FUNCTION OF GALAXY FLATTENINGS FOR CLUSTERS OF GALAXIES. Gainullina, R. Kh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 46-51(1972). (In Russian).

The necessity of rejecting the currently accepted suggestion of the chance distribution of angles between the tangent plane and the equatorial planes of cluster member galaxies is pointed out. The integral equation for frequency function of galaxy flattenings for clusters of galaxies, in which the effect of favorable orientation of the equatorial planes of cluster members manifests itself, is deduced. (auth)

23702 DIFFUSE GLOW OF THE TWO-LAYER GALAXY WITH CARBON-SILICON PARTICLES. Rozhkovskii, D. A.; Matyagin, V. S. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 52-63(1972). (In Russian).

The transfer of diffuse radiation in the Galaxy is considered. The galactic model consists of stellar population and dust which forms two homogeneous plane-parallel layers with different linear thickness. Equations of diffuse radiation transfer in the far uv and in the visual long-wave regions are solved numerically by means of the method of successive approximation. The parameters of the models are chosen on the assumption that the particles have a graphite-silicon structure and their properties in the spectral regions considered conform with the data by Wickramasinghe. The indicatrix of scattering is adopted from Hulstictial (1969). The obtained numerical values of the diffuse radiation intensity are compared with the calculations of van de Hulst and de Jong, for finding differences which are brought into the intensity calculation results by choosing one or another shape of the indicatrix. In the case considered this difference can be neglected up to the factor of asymmetry $\cos\gamma \leq 0.75$. The calculation results were compared with the observational results for diffuse radiation presented by Witt and Hayakawa et al., and it was found that, for the spectral regions considered, most probable are the albedo values >0.65 but <1 (in the region λλ 1200 to 1400 Å) and the values lying between 0.3 to 0.4 (λλ 6000 to 7000 Å), which conforms with the data by Wickramasinghe. The asymmetry factors show a poorer correspondence. They are obtained with less certainty and in both spectral regions prove to be more than 0.5. (auth)

23703 NUMERICAL SOLUTION OF THE EQUATION OF TRANSFER FOR DIFFUSE GALACTIC RADIATION IN TWO-LAYER PLANE-PARALLEL MODELS. Matyagin, V. S.; Rozhkovskii, D. A. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 64-71(1972). (In Russian).

A method for numerical solution of the equation of transfer for diffuse radiation in two-layer plane-parallel models of the Galaxy is considered. A block-diagram of the program for computer BESM-3M and calculation results for models of the Galaxy with different parameters are given. (auth)

23704 WAVY NATURE OF ROTATION CURVES IN GALAXIES. Makarenko, N. G. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 13-16(1972). (In Russian).

In the analysis of galaxy rotation curves one often notices the presence of regular deviations from smooth paths. One speaks here of the existence of "velocity waves". It is the intent of this paper to indicate how one might construct a simple stochastic model based upon weak interactions in galaxies that gives rise to an analogous pattern. By means of the stochastic integrals the spectrum of frequencies associated with that model is obtained and discussed. (auth)

23705 DO THE ELLIPTICAL GALAXIES ROTATE? Genkin, I. L.; Genkina, L. M. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 19: 8-12(1972). (In Russian).

Indirect evidences on rotation of the elliptical galaxies are considered. (auth)

23706 APERTURE SYNTHESIS SURVEY OF THE GALACTIC PLANE. Jones, B. B.; Finlay, E. A. (Univ. of Sydney). Aust. J. Phys.; 27: No. 5, 687-711(Oct 1974).

The results of a survey already published have been used to construct contour maps and ruled surface diagrams of the brightness temperature at 29.9 MHz near the galactic plane between $l = 225°$ and 30°. The angular resolution was 0 at 8° at the zenith, and the range of zenith angles involved was ±30°. Exploration of the background was achieved with the aid of a low resolution filled-aperture survey carried out by others. The brightness temperature scale was calibrated absolutely. The optical depth of the Galaxy in directions within 40° of latitude from the center has been estimated by a method which relies only on the shapes of brightness temperature profiles and not on absolute temperature calibrations. If an electron temperature is assumed, r.m.s. electron densities can be deduced. The average value of the disc emissivity at 29.9 MHz and the value of its spectral index have been calculated from brightness temperature profiles observed at a number of different frequencies, calibration being required for these purposes. About 29 discrete absorption regions have been observed and identified with optically observed HII regions, and the fact that these are all nearer than 4 kpc permits a choice between kinematic distances in two cases. The Carina nebula and RCW 108 lend themselves to the measurement of local emissivities, and values of these together with their implication have already been published. A number of previously unlisted non-thermal sources have been observed, many of which are objects of low surface brightness and probably are supernova remnants. (auth)

23707 WHY $^{12}C^{16}O$ PROFILES IN DARK CLOUDS DO NOT HAVE FLAT TOPS. Milman, A. S. (Univ. of Maryland, College Park). Astrophys. J., Lett.; 193: No. 2, L93-L96(15 Oct 1974).

The brightness temperature of $^{12}C^{16}O$ profiles in dark clouds usually varies over radial velocities where the line is judged to be optically thick. The shapes of the $^{12}C^{16}O$ and $^{13}C^{16}O$ profiles are discussed in terms of the theory of radiative trapping of Scoville and Solomon. It is concluded that the neutral-particle density in dust clouds is often low enough so that the excitation temperature of CO is less than the gas kinetic temperature. (auth)

23708 GIANT DOMINANCE IN E/SO GALAXIES. O'Connell, R. W. (Univ. of Virginia, Charlottesville). Astrophys. J., Lett.; 193: No. 2, L49-L51(15 Oct 1974).

Scanner observations of luminosity-sensitive TiO bands between 0.8 and 0.9 μ in the nuclei of five E/SO galaxies indicate that M giants contribute 10 to 20 percent of the light at these wavelengths and rule out dwarf-enriched models of the type previously suggested for Sb nuclei. The ratio of evolved to unevolved light is correspondingly increased, and thus evolutionary corrections to the luminosities of distant elliptical galaxies become larger. The TiO band at 8430 Å is stronger than can be accounted for by stars of normal metal content. (auth)

23709 SPACE DENSITY OF A STARS IN A REGION IN CASSIOPEIA. McCuskey, S. W. (Case Western Reserve Univ., Cleveland). Astron. J.; 79: No. 2, 107-115(Feb 1974).

New objective prism spectral types and UBV photometric data for B8-A3 stars, and a few others, with V < 12 mag are given for an area of 21.3 sq deg centered at R. A. 2^h14^m; Dec. + 60° (1950). McCuskey and Houk (1971) found in this region a high space density of these A stars extending from r = 250 to 650 pc. An analysis of this new data indicates that the high space density previously found was due to uncertainty in the variation of the interstellar absorption with distance, which had been derived from photometric data distributed over considerable ranges in galactic longitude and latitude. The present data indicate a maximum of space density of about 0.7 stars per $10^3 pc^3$ at r = 250 pc as compared with two or more found previously. (auth)

23710 A-STAR CONCENTRATION IN CASSIOPEIA. Pesch, P.; McCuskey, S. W. (Case Western Reserve Univ., Cleveland). Astron. J.; 79: No. 2, 116-123(Feb 1974).

A study by uvby, Hβ photometry, MK spectral types, and radial-velocity data for 99 A stars at l = 133°, b = -1° in Cassiopeia shows that: (a) the interstellar absorption $A_v \sim 1.3$ mag over r = 200 to 500 pc, but is greater in the cluster Stock 2; (b) the frequency distribution with distance of 86 A stars peaks at r = 250 pc and then declines to r = 500 pc. The extension in the line of sight is considerably less than that found by McCuskey and Houk (1971); (c) the A stars have a group motion relative to the LSR similar to the motion of the Sun in the (U,V) plane, but depart considerably from the solar motion in the W component; and (d) the space velocity distribution for A stars not members of Stock 2 differs considerably from that found by Schlesinger (1966) for B9-A5 stars. (auth)

23711 SIMPLE MODEL OF THE GALAXY WITH AN ALGEBRAIC DENSITY LAW. Saha, G.; Bandyopadhyay, K. (Jadavpur Univ., Calcutta). Indian J. Pure Appl. Phys.; 12: No. 9, 614-615 (Sep 1974).

A model of the Galaxy based on a new density law has been proposed. Using this law, the potential, attraction, circular velocity, volume, and projected densities in the plane of symmetry have been calculated. The total mass obtained in this model is comparable to that obtained in some other models, proposed by other workers. (auth)

23712 COSMIC DUST'S PART IN EVOLUTION OF THE INTERSTELLAR SPACE. Gidalevich, E. Ya. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 3-11(1966). (In Russian).

Cooling of the gaseous-dust medium because of nonelastic collisions of H-atoms with the dust leads to the origin of the cold solids with masses of 10^{25} gm. These bodies can perturb the gaseous medium. (auth)

23713 PROBLEM OF AN ABNORMAL ALBEDO OF THE DENSE DUST NEBULAE. Gidalevich, E. Ya. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 25-27(1967). (In Russian).

It has previously been shown that absorption of hydrogen atoms on the surface of dust particles is possible under conditions of dense gas-dust nebulae. It is shown here that origin of the conductive hard-hydrogen shell leads to a decrease of the particles' albedo in accordance with observational data. It is shown as an example of the extremely small dielectric particles. (auth)

23714 QUESTION OF THE ORIENTATION OF THE ELLIPTICAL NEBULAE. Denisyuk, E. K. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 21-24(1967). (In Russian).

A discussion is presented on the possibility of the determination of the elliptical galaxy orientation in space relative to an observer. (auth)

23715 ONE GENERALIZATION OF EDDINGTON-POINCARES EQUATION. Ivanov, Yu. I.; Omarov, T. B. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 18-20(1967). (In Russian).

A generalization is given of Eddington-Poincarè's equation for the case of a continuously decreasing aggregate of particles which is characterized by compact spherical structure and by a self-coordinated gravitational field in any moment of time. (auth)

23716 QUESTION OF THE ORIENTATION OF THE ELLIPTICAL NEBULAE IN THE SPACE. Denisyuk, E. K. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 45-56(1966). (In Russian).

A discussion is presented of the possibility of the determination of the elliptical galaxy orientation in space relative to an observer. (auth)

23717 NEW MODEL OF THE GALAXY AND CALCULATION OF STELLAR ORBITS. Genkin, I. L. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 16-25(1966). (In Russian).

A new dynamical model of the Galaxy is suggested. Its potential is considered as stationary. This permits the existence of Kuzmin's integral of stellar movements. A method of constructing stellar orbits completely lying in the galactic plane is given. (auth)

23718 AUTOMODEL TASK ON EXPRESSION OF A SHOCK-WAVE IN THE GASEOUS-DUST MEDIUM. Gidalevich, E. Ya. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 12-15(1966). (In Russian).

Shock-wave dynamics in gaseous-dust medium were investigated by the automodel method. Assumed gas density varies due to adsorption on the surface of the dust as $[\partial\rho/\partial t = k(\rho/t)]$. It is shown that adsorption of a gas or an evaporation of a dust can brake or accelerate the shock-wave. (auth)

23719 LIGHT PRESSURE OF STARS ON A DUST PARTICLE IN REFLECTION NEBULAE. Rozhkovskii, D.A.; Glushkov, Yu. I. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 28-33(1967). (In Russian).

Motion of particles having radii of 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, and 4×10^{-7} cm in radiational and gravitational fields of the star B3 is considered. It is shown, that in a nebula with a radius of 1.0 pc in 10^6 years the particles with radii of 4×10^{-7}, 10^{-6}, and 10^{-3} cm remained, on the condition that the hydrogen density is equal to 33×10^{-24} gm · cm^{-3} and 10^{-22} gm · cm^{-3}. The particles of other sizes overstep the limits of the luminous region of nebula. (auth)

23720 POLARIZATION OF LIGHT UPON ELONGATED PARTICLES. Kurchakov, A. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 34-39(1967). (In Russian).

A calculation of the polarization of diffusion light upon elongated particles is given. (auth)

23721 POLARIZATION OF LIGHT ON REFLECTION NEBULAE IN PLEIADES. Kurchakov, A. V. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 40-44(1967). (In Russian).

It is found that the radial polarization of light of reflection nebulae in Pleiades in general ranges from 0% to 25%. (auth)

23722 POLARIZATION OF LIGHT IN NEBULA IC 2118. Sabitov, Sh. N. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 45-47(1967). (In Russian).

Observations of the polarization of the IC 2118 nebula are discussed. It is found, that in the northern and central parts of this nebula there is the radial polarization relative to the β Orionis star. (auth)

23723 UPPER LIMIT TO THE NEUTRAL HYDROGEN CONTENT OF THE ELLIPTICAL GALAXY NGC 4472. Knapp, G. R.; Kerr, F. J. (Univ. of Maryland, College Park). Astron. J.; 79: No. 6, 667-670(Jun 1974).

The large elliptical galaxy NGC 4472 was observed in the 21-cm line of neutral hydrogen in a search for HI emission. No HI was found in the galaxy; at an assumed distance to the galaxy of 11.5 Mpc, this implies an HI mass less then $10^8 M_\odot$ if the emission can be assumed to be confined to a total velocity range of 500 km/sec or less. The HI content of the galaxy is then less than 0.006% by mass, much lower than the amount of interstellar matter which is expected to exist in the galaxy due to mass loss by stars. Several possible explanations are considered. (auth)

23724 FAINT ENVELOPES OF GALAXIES. Kormendy, J. (Hale Observatories, Pasadena, CA); Bahcall, J. N. Astron. J.; 79: No. 6, 671-677(Jun 1974).

Photographic surface photometry is presented for 12 fields containing small and moderately rich groups of galaxies, as well as isolated galaxies of various morphological types. Surface brightnesses of 26 to 28 green mag per square arcsec are reached using isodensity tracings with small density steps. Star images provide the magnitude calibrations. Observations confirm the existence of faint envelopes $\gtrsim$100 kpc in diameter previously reported for elliptical galaxies by de Vaucouleurs (1969) and Arp and Bertola (1969, 1971). When measured at the same surface brightness, spiral galaxies are not substantially smaller than ellipticals of the same luminosity. Some groups of galaxies dominated by ellipticals are imbedded in common luminous envelopes up to 1.3 Mpc in diameter. In the Coma cluster there is evidence for more luminosity than would be produced by overlapping galaxy halos. The NGC 383 grouping of ellipticals, and the NGC 3623 group of spirals show no definite intergalactic matter at 27 green mag per square arcsec. If intergalactic matter is present with a mass at least equal to that in visible galaxies, it must have a mass to light ratio $\gtrsim$3(M/L) galaxies. The isodensity tracing technique is examined in detail in an Appendix. Various photographic and optical effects that might produce spurious halos are shown to be negligible. However, plate background variations are important, and make 103a emulsions more suitable for tracing than the baked IIIa-J emulsion. Generally, isodensity tracing is found to be suitable for rapid survey work at faint light levels, but is insufficiently accurate for precise photometry. (auth)

23725 INTERSTELLAR CIRCULAR POLARIZATION: RESULTS FROM A SURVEY OF 84 STARS. Stokes, R. A.; Swedlund, J. B.; Avery, R. W.; Michalsky, J. J. (Battelle-Northwest Labs., Richland, WA). Astron. J.; 79: No. 6, 678-681(Jun 1974).

Circular polarization observations of 84 bright stars were carried out on the Battelle 79-cm telescope during the one-year period ending 1973 August. The survey was aimed at detecting circular polarization at the 0.01% level due to interstellar dust. Thirteen stars were found to be circularly polarized. (auth)

23726 LINEAR STABILITY OF SINGLE PHASE SPACE HOLES. Doremus, J. P.; Baumann, G. (Univ., Nancy). Astron. Astrophys.; 32: No. 1, 47-49(Apr 1974).

The linear stability of one dimensional stellar systems with a

double Water-Bag distribution function was studied. The eigenfrequencies of the system were computed and the results were compared with the numerical experiments of Cuperman and Tzur. Only the asymptotic eigenfrequencies were considered and an expression is given for the instability growth rate. (auth)

23727 TWO FAINT COMPANIONS TO M 81. Bertola, F. (Univ., Padua). Astron. Astrophys.; 32: No. 1, 117-119(Apr 1974).

A description of two faint galaxies in the field of M 81 is given. The brighter is of spheroidal type while the other one is of Magellanic type. They have a counterpart in IC 1613 and in the Fornax system in the Local Group. (auth)

23728 COMET-LIKE STRUCTURE IN NGC 7635. Johnson, H. M. (Lockheed Missiles and Space Co., Palo Alto, CA). Astron. Astrophys.; 32: No. 1, 17-19(Apr 1974).

A plate of the galactic nebula NGC 7635 clearly shows a comet-like structure inside the ring structure. Its unusually strong, continuous spectrum is illustrated. Present concepts of the nebula may not easily account for the orientation of the comet-like structure. (auth)

23729 OBSERVATIONS OF THE INTERSTELLAR NA 3302 DOUBLET AND THE INTERSTELLAR SODIUM ABUNDANCE. de Boer, K. S.; Pottasch, S. R. (Univ. of Groningen, Netherlands). Astron. Astrophys.; 32: No. 1, 1-5(Apr 1974).

Observations are presented of the interstellar neutral sodium uv doublet at 3302 Å (to be called Na U doublet). Together with the scarce U line data in the literature, these form the basis for deriving accurate Na column densities, which are an order of magnitude larger than values derived from the D lines alone. After allowance for ionization balance it is found that in these clouds with strong D lines, the ratio of total sodium to hydrogen is close to the solar abundance value. Using both doublets (U and D) it is found that the internal doppler velocities are of the order of 1 to 3 km s^{-1} in most clouds. (auth)

23730 UBV PHOTOELECTRIC STUDY OF NGC 3379, 3384, AND 3389. Burkhead, M. S.; Kalinowski, J. K. (Indiana Univ., Bloomington). Astron. J.; 79: No. 8, 835-845(Aug 1974).

The results obtained from UBV photoelectric drift scans along several paths through the galaxies NGC 3379, 3384, and 3389 are presented. The NGC 3379 data are in excellent agreement with the earlier work of Miller and Prendergast and extend the detected limits of the galaxy to 450 arcsec. NGC 3379 is found to be very symmetric and a mean profile is presented in empirical and analytic form. NGC 3384 possesses a distinct exponential disk which favors an SO or SBO classification. The scans indicate a distinct overlap in the intensity profiles of NGC 3379 and 3384. While arguments suggest that most of this overlap is due to a projection effect, there may be some physical interaction between the pair. Observations of NGC 3389 are consistent with both Sc and Irr classifications. Several arguments strongly suggest that NGC 3389 is a background galaxy not associated with NGC 3379 or 3384. An unusual feature in B along the major axis of NGC 3389 does, however, provide some suggestion of the possible association of this galaxy with the other two. Integrated magnitudes are presented for each galaxy and compared with previously published determinations. (auth)

23731 FAINT BLUE STARS BEYOND THE PERSEUS ARM. Muzzio, J. C.; Rydgren, A. E. (Univ. of Arizona, Tucson). Astron. J.; 79: No. 8, 864-865(Aug 1974).

A search for faint O-B3 stars has been made in four regions of the Milky Way in the longitude range $135° < l < 180°$, using a transmission grating and UBV photoelectric photometry. The search is complete in the magnitude range $12.0 \leq B \leq 14.5$ and covers about 1300 sq arcmin in each region. A total of eight stars have been found whose photometric colors indicate spectral types of B3 or earlier. These stars are all probably located beyond the Perseus arm. (auth)

23732 CATALOG OF 86 NEW STAR CLUSTERS IN THE SMALL MAGELLANIC CLOUD. Hodge, P. W.; Wright, F. W. (Harvard Coll. Observatory, Cambridge, MA). Astron. J.; 79: No. 8, 858-859(Aug 1974).

Eighty-six new star clusters that apparently belong to the Small Magellanic Cloud were recognized on Curtis Schmidt plates, bringing the number of cataloged clusters to a total of 220. Positions and descriptions are given for the new clusters. (auth)

23733 SURVEY OF THE GALACTIC BACKGROUND RADIATION AT 3.93 AND 6.55 MHz. Alexander, J. K.; Navaco, J. C. (Goddard Space Flight Center, Greenbelt, MD). Astron. J.; 79: No. 7, 777-785(Jul 1974).

A survey of the galactic background radiation at 3.93 and 6.55 MHz is presented for the region between declinations of $-60°$ and $+60°$. The observations were obtained with the 229-m traveling-wave V-antenna on the Radio Astronomy Explorer-1 satellite with an angular resolution of the order of one steradian. The results are consistent with the findings of high-resolution ground-based surveys at low frequencies and provide a first step in extending such observations over the whole sky. (auth)

23734 H 92α RECOMBINATION LINE OBSERVATIONS OF M16. Zeilik, M. II; Lada, C. J. (Harvard Coll. Observatory, Cambridge, MA). Astron. J.; 79: No. 7, 786-790(Jul 1974).

A 40 by 40 arcmin region of the galactic nebula M16 was mapped at 30 locations in the H 92α recombination line. From the observed α-line parameters, it was found that the LTE electron temperatures vary from 4000 to 10,000°K and generally increase from the center to the nebula's edge. The radial velocity map shows no coherent structure on a scale characteristic of the 4'.2 beam. Either the mass motions in M16 are chaotic or they occur systematically over regions smaller than a few parsecs. The He 92α line, previously undetected in M16, at the nebula's center was also observed and the apparent relative abundance of ionized helium to ionized hydrogen was calculated as 0.05. (auth)

23735 COSMOLOGICAL IMPLICATIONS OF AVAILABLE COUNTS IN CLUSTERS OF GALAXIES. Noonan, T. W. (Brockport State Coll., NY). Astron. J.; 79: No. 7, 775-776(Jul 1974).

The mean radii of 23 clusters of galaxies are determined from available counts, and the quantities $y = 1 + \log_{10} z\,\bar{r}$ are calculated, where z is the cluster redshift and $\bar{r}$ is the mean radius in arcmin. The use of weighted linear least squares fitting gives a correlation $y = a + bz$, where $a = 0.81 \pm 0.04$ and $b = -0.28 \pm 0.35$ (s.e.), which may be compared with $b \gtrsim +0.5$ in Friedmann models. Various sources of possible errors are discussed. (auth)

23736 21-cm STUDY OF PECULIAR GALAXIES. Peterson, S. D. (Cornell Univ., Ithaca, NY); Shostak, G. S. Astron. J.; 79: No. 7, 767-774(Jul 1974).

The 21-cm HI spectra of 23 objects drawn from Arp's Atlas of Peculiar Galaxies are presented. These spectral profiles, which are sensitive to large scale asymmetries in either the HI distribution or velocity field, show wide variations, with the most unusual spectra being generally associated with the most morphologically perturbed systems. The integral mass and luminosity properties are derived and compared with those compiled from a sample of normal galaxies. The peculiar objects have integral property ratios which are similar in value and dispersion to those of the normal systems. (auth)

23737 PLANCK MEAN CROSS-SECTIONS FOR FOUR GRAIN MATERIALS. Gilman, R.C. (University of Minnesota). Astrophys. J. Suppl. Ser. 28: No. 268, 397-403 (Nov 1974).

Planck mean absorption and radiation-pressure cross-sections have been computed for spherical and spheroidal grains composed of olivine, iron, silicon carbide, or graphite. The spherical grain radii range from 10^{-7} to 10^{-3} cm, while the effective temperature of the Planck function used in calculating these means ranges from 10° to 40,000°K. (auth)

23738 COLUMN DENSITIES OF INTERSTELLAR MOLECULAR HYDROGEN. Spitzer, L. Jr.; Cochran, W.D.; Hirshfeld, A. (Princeton University Observatory). Astrophys. J. Suppl. Ser. 28: 373-389 (Oct 1974).

Equivalent widths of some 50 lines in the 0-0 to 5-0 Lyman bands of H_2 are reported in the spectra of 28 stars. Curves of growth are given and column densities for levels from J=0 to J=5 are tabulated, with a few values and upper limits for N(6) and N(7), together with values for b, the velocity spread parameter. In three Orion stars and in ρ Leo pairs of components are detected, the difference in radial velocity determined, and column densities measured or estimated; tentative identifications are made with the components observed by Hobbs in the Na D-lines. Column densities for HD are given for 13 stars. Upper limits for column densities in the first and second vibrational levels are listed for several stars; the ratio of N(J=0) in the $v''=1$ level to that in the ground vibrational level is less than 2.4×10^{-8} in ζ Oph. Values of T_{01}, a rotational excitation temperature for the higher J levels, are given for all the stars. Data are presented showing an apparent increase of velocity dispersion with J for a number of stars, as measured both from the curves of growth and from line widths. (auth)

23739 AN ATLAS OF DUST AND H II REGIONS IN GALAXIES. Lynds, B. T. (Kitt Peak National Observatory, Tucson, Arizona). Astrophys. J., Suppl. Ser.; 28: 391-396(Nov 1974).

23740 SILICON CARBIDE: ITS GROUND STATE AND PREDICTED SPECTRUM. Lutz, B.L. (Department of Earth and Space Sciences, State University of New York at Stony Brook); Ryan, J.A. Astrophys. J. 194: No. 3, 753-756 (15 Dec 1974).

Ab initio studies of the SiC molecule using SCF-CI techniques resulted in specifying the ground state as $^3\Pi_i$. A rotational transition is predicted at 109 GHz, while the fundamental vibration is expected at

983 cm^{-1} ($\lambda = 10.2\ \mu$). In addition, an electronic transition of the type $^3\Sigma^- - {}^3\Pi_i$ is predicted in the $1-3\mu$ region. (auth)

23741 MOLECULAR STUDIES OF TWO DARK NEBULAE ASSOCIATED WITH HERBIG–HARO OBJECTS. Lada, C.J.; Gottlieb, C.A.; Litvak, M.M.; Lilley, A.E. (Center for Astrophysics, Harvard College Observatory). Astrophys. J. 194: No. 3, 609-618 (15 Dec 1974).

Narrow ($\lesssim 2$ km s^{-1} wide) emission lines from millimeter– and centimeter–wave transitions of a number of molecules have been detected toward several dark nebulae known to contain H–H objects and infrared stars that are thought to be very young. Large dense clouds have been mapped in 2–mm H_2CO emission toward NGC 1333 and M78. Determinations of nearly constant kinetic temperature through ^{12}CO and NH_3 observations in NGC 1333 indicate that the slight peaking of the emission from H_2CO, CS, and HCN is probably due to increased gas density near the H–H object/infrared–star associations. The observations and radiative–transfer models yield a probable lower limit of $\gtrsim 2 \times 10^4$ cm^{-3} to the hydrogen density in NGC 1333. Gravitational–collapse velocities implied by the mass of $\sim 10^3$ $M_\odot$, assuming this density is uniform over a spherical cloud, are much larger than those allowed by the observed narrow molecular line widths. (auth)

23742 THE SCATTERING BY DUST IN THE ORION NEBULA. Schiffer, F.H. III; Mathis, J.S. (Washburn Observatory, The University of Wisconsin–Madison). Astrophys. J. 194: No. 3, 597-608 (15 Dec 1974).

New observation of the scattered continuum in the Orion Nebula are presented and discussed. Three types of theoretical models of the dust are discussed: (1) spherically symmetric ones, with the star at the center of the dust distribution; (2) slab models, with the scattering occurring at the front face of the very dense, opaque H I region which lies behind the nebula; (3) composite models, with both a spherical and a slab distribution. The ultraviolet extinction of θ Ori implies that almost all of the extinction is peculiar and therefore probably occurs within the nebula. The optical data lead to an estimate of an optical depth at Hβ of 1.5–2. Composite models, with scattering from both the slab and a foreground shell of optical depth ~ 2 (from the observations of the star), indicate that most of the scattered light at visual arises from the shell. Observations require that there is little scattering by any dust within 2′–3′ in front of the Trapezium. Neutral condensations, which seem to exist near the Trapezium, must therefore not scatter efficiently, presumably because they are very small and possibly optically thick in dust. The albedo of the dust in the center regions is 0.6–0.7. Other means for studying the dust are discussed briefly. (auth)

23743 THE NATURE OF SMALL GROUPS OF GALAXIES IN THE LOCAL SUPERCLUSTER. Turner, E.L.; Sargent, W.L.W. (Hale Observatories, California Institute of Technology). Astrophys. J. 194: No. 3, 587-592 (15 Dec 1974).

We examine the nature of the 54 groups of galaxies in the Local Super cluster(LSC) given in de Vaucouleurs's list. We find from three independent tests, described in § II, that the LSC contains two distinct kinds of groups. Only 13 of the 44 groups for which good data are available are likely to be bound systems. The rest are probably loose aggregates of neighboring field galaxies which are expanding apart in the Hubble flow in the manner proposed by Gott, Wrixon, and Wannier. Rood, Rothman, and Turnrose carried out a virial analysis of 50 groups, and suggested, among several other hypotheses, that many of the groups might not be bound systems. We show that the 13 groups which pass our tests contain a higher proportion of early–type galaxies and have a significantly lower median virial mass discrepancy, log (M_{VT}/ML) ~ 1.0, than those which fail one or more tests. We also show that two correlations, $M_{VT}/M_L \sim V^{1.5}$ and $M_{VT}/M_L \sim R^{1.1}$, discovered by Rood et al., are artifacts of the method of analysis. The statistical application of the virial theorem to the local galaxies by Geller and Peebles is considered in § III. We conclude that the existence of a large number of unbound density enhancements modifies their results. The statistics of the angular separations of pairs of galaxies computed by Geller and Reebles are shown to be consistent with our estimate of the number of bound and unbound groups. In general, we conclude that a virial–theorem mass discrepancy of the order $\langle M_{VT}/M_L \rangle \sim 10$ still exists for the nearby, bound groups of galaxies, although it is much smaller than estimated by Rood et al., and by Geller and Peebles. (auth)

23744 AN INTERPRETATION OF RING GALAXIES AND THE PROPERTIES OF INTERGALACTIC GAS CLOUDS. Freeman, K.C. (Mount Stromlo and Siding Spring Observatory, Australian National University, Canberra); de Vaucouleurs, G. Astrophys. J. 194: No. 3, 569-585 (15 Dec 1974).

We propose that the pairs of peculiar spheroidal galaxies associated with ring–type objects (e.g., IC 298=Arp 147) or chaotic multinucleated objects (e.g., NGC 2444–5=Arp 143) result from encounters of normal spirals with intergalactic H I clouds. Observational constraints restrict the cloud parameters to a small range around $M = 3 \times 10^9 M_\odot$, R=15 kpc, N=25 Mpc^{-3}. A significant fraction of normal lenticular galaxies and of late–type Magellanic irregulars could have been produced by such galaxy–cloud encounters, as remnants of respectively the old stellar component and of the gas disk component. We suggest that some "isolated extragalactic H II regions" (e.g., I Zw 18 and II Zw 40) could result from cloud–cloud encounters. Specific models of individual peculiar galaxies based on this concept are presented. (auth)

23745 FURTHER EVIDENCE FOR AN EXPLOSIVE EVENT IN THE PECULIAR GALAXY NGC 1569. de Vaucouleurs, G.; de Vaucouleurs, A.; Pence, W. (McDonald Observatory and Department of Astronomy, University of Texas, Austin). Astrophys. J. Lett. 194: No. 3, L119-L123 (15 Dec 1974).

The suggestion originally made by Zwicky and independently by Hodge that the Hα emission filaments in the dwarf Magellanic irregular NGC 1569 are the aftermath of an explosive event is supported by a discussion of available photometric, spectroscopic and radio data and by a new interferometric study. A tentative model of the galaxy and exploded filaments is presented. Residual radial velocities of up to ± 60 km s^{-1} are observed, suggesting an expansion age of $(1-2) \times 10^7$ yr. (auth)

23746 DIRECT ELECTRONOGRAPHIC OBSERVATIONS OF LUMINOUS CONNECTIONS BETWEEN GALAXIES WITH DISCORDANT REDSHIFTS. Walker, M.F.; Pike, C.D. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz); McGee, J.D. Astrophys. J. Lett. 194: No. 3, L125-L127 (15 Dec 1974).

Direct electronographic observations have been obtained of the systems NGC 4319 plus Markarian 205, Seyfert's Sextet, and NGC 7603 plus companion, using Spectracon image converters at the prime focus of the 120–inch reflector to investigate the existence of luminous connections between galaxies of very different redshift. No evidence of such connections was found in the first two objects. A luminous filament does indeed extend between NGC 7603 and its companion, but the observations give no indication between the companion and the luminous material. (auth)

23747 AN ADDITIONAL CONSTRAINT ON THE EARLY EVOLUTION OF THE GALAXY FROM NEW OBSERVATIONS OF 47 TUCANAE. Hartwick, F.D.A. (University of Victoria); Hesser, J.E. Astrophys. J. Lett. 194: No. 3, L129-L133 (15 Dec 1974).

Photoelectric observations of 100 stars in the globular cluster 47 Tucanae have been obtained at Cerro Tololo; when combined with recent work by Cannon and Menzies, a composite photoelectric color–magnitude diagram of 180 stars, 40 of which lie on or below the turn–off, can be constructed. From it and a photographic–luminosity function obtained from ~ 1500 stars we estimate: $E(B-V) = 0.04$, $[Fe/H] = -0.48$, $(m-M)_0 = 13.03$, $10.3 \lesssim$ age $\lesssim 13.7 \times 10^9$ yrs, and $Y \sim 0.23$; these results are consistent with the Eggen, Lynden–Bell and Sandage collapse picture of the formation of the halo of our Galaxy. (auth)

23748 ON THE RELATIONSHIP OF OH AND FORMALDEHYDE WITH INTERSTELLAR EXTINCTION. Turner, B.E. (National Radio Astronomy Observatory, Green Bank, West Virginia); Heiles, C.E. Astrophys. J. 194: No. 2, 525-535 (1 Dec 1974).

We have mapped the distribution of OH and of H_2CO in two regions in Taurus where the photographic extinction varies from 2 to 7 magnitudes. A high degree of correlation is found between the extinction and both the excitation temperature of OH and the strength of absorption in the 6–cm line of H_2CO. No correlation is found between OH abundance and extinction. From these observations, and similar ones by Knapp showing that the strength of self–absorption of atomic hydrogen is also correlated with extinction, we deduce that (a) OH abundance is independent of extinction; (b) the OH is probably subthermally excited in these regions, although this implies an ionization fraction $\lesssim 4 \times 10^{-6}$; (c) the anomalous excitation of the 6–cm H_2CO transition is probably collisional rather than radiative. To explain the independence of OH abundance and extinction, we conclude that OH formation probably occurs via ion–molecule reactions rather than by neutral gas phase reactions of by reactions on grain surfaces. (auth)

23749 RADIATIVE AND PREDISSOCIATION PROBABILITIES FOR INDIVIDUAL ROTATIONAL LEVELS OF THE B $^2\Sigma^-$ STATE OF CH WITH APPLICATION TO THE RADIATIVE RECOMBINATION OF CH IN THE INTERSTELLAR MEDIUM. Brooks, N.H.; Smith, W.H. (Princeton University Observatory). Astrophys. J. 194: No. 2, 513-517 (1 Dec 1974).

The dependence of radiative lifetime for individual rotational levels of the B $^2\Sigma^-$ state ($v' = 0,1$) has been determined from phase shift, radiative–lifetime measurements. The onset of predissociation occurs sharply at $N' = 15$, $v' = 0$, and $N' = 7$, $v' = 1$. These data, as a function of the rotational quantum number, yield an improved estimate of the dissociation energy for the B $^2\Sigma^-$ state and imply that shape resonance effects lead to a substantial enhancement of the radiative association rate under conditions appropriate to interstellar H I regions (auth)

23750 EFFECTS OF A FREE–FREE RADIO CONTINUUM ON THE POPULATIONS OF HIGH ATOMIC LEVELS AT LOW TEMPERATURES AND DENSITIES. Ahmad, I.A. (Kitt Peak National Observatory, and Steward Observatory, University of Arizona). Astrophys. J. 194: No. 2, 503-512 (1 Dec 1974).

Calculations of the departure coefficients have been performed for atomic levels $50 \leq n \leq 285$ at temperatures ($T = 10°, 20°, 100°, 1000°K$) and densities ($10^{-3} \leq N_e \leq 10^{3}$ cm^{-3}) found to occur in H I regions, and in the presence of a radiofrequency continuum due to bremsstrahlung. I have included hitherto neglected $|\Delta n| > 1$ radiatively induced transitions in the equilibrium equations. The quantity $(1-b_n/b_{n+1})$ related to stimulated emission has also been calculated. The results are compared with those from previous calculations. Applying the results to Orion A, I find that the ratio of the α to β line intensities greatly reduces the lower limit on the range of densities permitted in the H I region from that previously believed. (auth)

23751 DIFFUSE INTERSTELLAR BAND FORMATION IN DENSE CLOUDS. Snow, T.P. Jr. (Princeton University Observatory); Cohen, J.G. Astrophys. J. 194: No. 2, 313-322 (1 Dec 1974).

Data are presented which show that the strengths of the diffuse interstellar bands at 4430, 5780, and 5797 Å tend to be deficient with respect to color excess in the lines of sight to stars lying behind dense interstellar clouds. In addition, diffuse–band data for 10 stars in the well–studied ρ Ophiuchi cloud complex are presented, and systematic variations of band strengths with optical depth are discussed. It is found that the band strength per grain in the line of sight apparently decreases with increasing grain size, taking the ratio of total–to–selective absorption and the wavelength of maximum polarization as indicators of the latter. It is concluded that diffuse–band formation probably takes place most efficiently in the outer regions of interstellar clouds. This may be consistent with a diffuse–band origin in small grains which are coated by mantles in cloud interiors; or in some molecule or molecules which are most abundant in the outer portions of interstellar clouds. (auth)

23752 A VELOCITY SEPARATION OF STARS AND GAS IN CARINA. Humphreys, R.M. (University of Minnesota, Minneapolis); Kerr, F.J. Astrophys. J. 194: No. 2, 301-311 (1 Dec 1974).

In the Carina spiral feature near $l = 290°$ a significant difference of 10–20 km s^{-1} is observed between the motions of the young stars and neutral hydrogen gas. At $l = 289°$ and 290° the H I temperature contours appear shifted to positive velocities with respect to the stars and to the H I gas directly on either side. The H II regions agree well in velocity with the H I gas. There is also a discrepancy of 10–20 km s^{-1} between the velocity residuals of the stars and H II regions which are at similar photometric distances. These observations are considered evidence for a real kinematic difference between the young stars and gas near $l = 290°$. The region of these anomalous motions may extend from 3 to 7 kpc from the Sun and is only 2° wide in longitude. This region may best be described as a narrow sheet, particularly since the extent in latitude is uncertain. Two possible interpretations of the optical and radio evidence for spiral structure would place this peculiar region either on the inner side of the spiral feature or along the central axis of the optical spiral arm. The observed velocity anomaly has the right sign and a reasonable amplitude for a shock–front effect, and the applicability of Roberts's shock–wave model of spiral structure to this anomalous region is discussed. (auth)

23753 AN EXPERIMENTAL TEST OF THE HOMOGENEITY OF THE INTERSTELLAR MEDIUM. Baker, P.L. (Radio Astronomy Branch, Laboratory for Extraterrestrial Physics, Goddard Space Flight Center). Astrophys. J. 194: No. 2, 271-277 (1 Dec 1974).

Observations of nonthermal continuum radio emission at 750 MHz and hydrogen–line emission at 1420 MHz have been compared in order to test the extent to which cosmic–ray electrons, magnetic fields, and hydrogen gas coexist in the interstellar medium. If the interstellar medium is homogeneous in the sense that its constituents are mixed together and can interact, then regions of line and continuum emission should be spatially correlated. The measurements indicate that at most 28 percent of continuum emission in the Galaxy comes from such a homogeneous medium. The remaining nonthermal emission agrees in magnitude with the residual emission found by Berkhuijsen after subtraction of the polarized component of nonthermal emission. In addition, the data discussed here show that the major filamentary structures found in the two forms of emission rarely coincide spatially. Consequently, both the average and the exceptional structure in the medium indicate that the synchrotron–radiating magnetoplasma and the neutral hydrogen gas are not closely interacting in the present state of the medium. (auth)

23754 INTENSE SUB–ARCSECOND STRUCTURE IN THE GALACTIC CENTER. Balick, B. (Lick Observatory, Board of Studies in Astronomy and Astrophysics, University of California, Santa Cruz); Brown, R.L. Astrophys. J. 194: No. 2, 265-270 (1 Dec 1974).

The detection of strong radio emission in the direction of the inner 1–pc core of the galactic nucleus is reported. The structure is bright (brightness temperature $\gtrsim 10^{7}°$K), unresolved ($\theta \lesssim 0.''1$), and distributed within a few seconds of the brightest infrared and radio emission seen previously. (auth)

23755 THE NUCLEUS OF M31. Light, E.S.; Danielson, R.E.; Schwarzschild, M. (Princeton University Observatory). Astrophys. J. 194: No. 2, 257-263 (1 Dec 1974).

The nucleus of M31 was photographed at a resolution of 0.''2 with the 91–cm balloon–borne Stratoscope II telescope. At the half–intensity level, the nucleus was observed to be elliptical (1.''0×1.''6) with its major axis lying in position angle 63°±5°. The peak surface brightness was 12.7±0.3 V mag per square second of arc assuming B – V = 1.0. The nucleus appears to be a separate feature from the bulge with a scale height of approximately 0.5 pc. The mass of the nucleus is of the order of 10^{8} $M_{\odot}$, and the apparent visual mass–to–light ratio is of the order of 20. (auth)

23756 INFRARED MAP OF THE ORION NEBULA. Lembe, D. (Max-Planck-Institut fuer Astronomie, Heidelberg); Low, F. J.; Thum, C. Astron. Astrophys.; 32: No. 2, 231-233(May 1974).

The Orion Nebula complex was mapped at 21 μ with a 1 arc min beam. The flux from the entire region was found to be 1.5×10^{-21} W m^{-2} Hz^{-1}. Therefore the Orion Nebula is the brightest 21 μ object outside the solar system studied so far. (auth)

23757 NATURE OF THE DISTRIBUTION OF GALAXIES. Peebles, P. J. E. (Univ. of California, Berkeley). Astron. Astrophys.; 32: No. 2, 197-202(May 1974).

A striking result has emerged from estimates of the covariance function for the distribution of galaxies. Within the limits of random and systematic errors, there is no evidence of anti-correlation of galaxy positions on any observed scale— there are not holes around clusters. Rather, the covariance function varies as a simple power law over a large range of the argument. To the accuracy one can estimate it, this statistic gives no evidence of a natural division between groups and clusters of galaxies, or between clusters and superclusters. (auth)

23758 PHOTOELECTRIC PHOTOMETRY OF GASEOUS NEBULAE. II. The Temperature and Ionization Structure of M 8 and M 20. Dopita, M. A. (Univ. of Manchester, Eng.). Astron. Astrophys.; 32: No. 2, 121-126(May 1974).

An analysis was made of the photoelectrically measured intensities of the Hα, Hβ, [N II] λ 6584 Å, and [O III] λ 5007 Å nebular lines at 96 points in M 8 and 31 points in M 20. This yielded the variation in temperature and ionization conditions in these nebulae. In the case of M 8 very low oxygen and nitrogen abundances in the ionized gas were inferred when compared to solar abundance, and it is concluded that in both M 8 and M 42 (observed earlier) a large fraction of the oxygen is locked up in the dust. There is strong evidence of large optical depth variations apparently caused by neutral inclusions of material in the nebulae. In both M 8 and M 20 there must be substantial quantities of neutral helium present in the ionized gas, and in the case of M 8 this implies that helium ionizing photons are probably preferentially absorbed on the dust. (auth)

23759 DYNAMICAL MODELS OF ELLIPTICAL GALAXIES. Wilson, C.P. (Department of Astronomy, University of California, Berkeley, California 94720). Astron. J. 80: No. 30, 175-187 (Mar 1975).

Self–consistent dynamical models are constructed for elliptical galaxies by solving Poisson's equation. They possess rotational symmetry and differential rotation. The density is obtained by integrating over all velocities a near–Gaussian distribution function that depends on energy and angular momentum with two free parameters. Observable properties are predicted by projecting the three–dimensional models onto the plane of the sky. The models give radial intensity profiles and isophote shapes that agree quite well with observations of NGC 3379, and they also predict a rotation curve consistent with the one observed. Models with different intrinsic flattenings fit the observations about equally well if different assumptions are made concerning the orientation of NGC 3379 in space. Only the models less flattened than about E4 possess radial intensity profiles similar to those of most elliptical galaxies. The variation of flattening with radius in the models is always peaked, whereas real galaxies possess a great variety of forms. The models flatter than about E4 violate the Ostriker–Peebles stability criterion. An appendix discusses numerical techniques. (auth)

23760 DUST IN THE REFLECTION NEBULA SURROUNDING VY CANIS MAJORIS. Jura, M. (Department of Astronomy, University of California, Los Angeles, California 90024). Astron. J. 80: No. 30, 227-231 (Mar 1975).

We show that the observations of the polarization and colors in the reflection nebula surrounding VY CMa can be roughly reproduced by a simple spherically symmetric model. To account for both the near greyness of the scattered light and the very high polarization, we suggest both that the dust grains are somewhat larger than those in the normal interstellar gas and that the grains have a large imaginary component of their index of refraction. Using these same grains, we

sketch a model to explain the observed infrared linear and circular polarization. (auth)

23761 STELLAR CONTENT OF THE NUCLEI OF ELLIPTICAL GALAXIES DETERMINED FROM 2.3-MICRON CO BAND STRENGTHS. Frogel, J.A.; Persson, S.E. (Center for Astrophysics, Harvard College Observatory, Smithsonian Astrophysical Observatory); Aaronson, M.; Becklin, E.E.; Matthews, K.; Neugebauer, G. Astrophys. J. Lett. 195: No. 1, L15-L18 (1 Jan 1975).

Observations of the luminosity-sensitive CO absorption band at 2.3 μ are presented for the nuclei of 16 E and SO galaxies. Preliminary data on the radial variation of the CO index in six galaxies are also given. The data show that the 2-μ radiation from the nuclei is dominated by high-luminosity stars of integrated spectral type later than K5. There is a small variation in the CO absorption from galaxy to galaxy, and a slight variation with measuring aperture size from 17".5 to 59". The data can be used to synthesize stellar populations for elliptical galaxy nuceli. (auth)

23762 ION-ATOM CHARGE-TRANSFER REACTIONS AND A HOT INTERCLOUD MEDIUM. Steigman, G. (Yale University Observatory). Astrophys. J. Lett. 195: No. 1, L39-L41 (1 Jan 1975).

The ratios of CII/CII and CII/CI observed toward several unreddened stars are inconsistent with radiative recombinations in a hot, partially ionized intercloud medium. The observed underabundance of CIII and overabundance of CI may be due to previously neglect of charge-transfer reactions. It is shown that, if the reaction $C^{++} + H \rightarrow C^{+} + H^{+}$ proceeds rapidly ($k \simeq 10^{-11}$ cm^3 s^{-1}), then the observed CIII underabundance can be understood. Similarly, the observed CIII underabundance can be understood. Similarly, the observed CI overabundance may be the result of the reaction $C^{+} + H \rightarrow C + H^{+}$ being rapid ($k \simeq 10^{-12}$ cm^3 s^{-1}). Although no laboratory data exist on these reactions at thermal energies (T-10^4°K; E-1 eV), the required rate coefficients are not unreasonably large. If, indeed, the rate coefficients are of the order of magnitude suggested above, then the observations of carbon toward several unreddened stars are consistent with the presence of a hot ($T \simeq 10^4$°K), intercloud medium. (auth)

23763 OBSERVATIONS OF CARBON RECOMBINATION-LINE EMISSION IN THE REFLECTION NEBULA M78. Brown, R.L. (National Radio Astronomy Observatory, Green Bank, West Virginia); Knapp, G.R.; Kuiper, T.B.H.; Kuiper, E.N.R. Astrophys. J. Lett. 195: No. 1, L23-L25 (1 Jan 1975).

The C 166α and C 142α recombination lines have been detected in the reflection nebula M78. The line emission arises in a cold (T$\simeq$20°K) C II Strömgren sphere ionized by HD 38563 N and S, the exciting stars of M78 that are embedded in the dark cloud L1630. The observed lines are extremely narrow, the full width at half-maximum $\Delta V < 1.3$ km s^{-1}, making these the narrowest radio recombination lines yet detected. (auth)

23764 SEARCH FOR CONTINUOUS FLUORESCENCE IN REFLECTION NEBULAE. Rush, W.F.; Witt, A.N. (Ritter Astrophysical Research Center, The University of Toledo, Toledo, Ohio 43606). Astron. J. 80: No. 1, 31-36 (Jan 1975).

Photometric and spectrophotometric observations have been made of the reflection nebulae NGC 1435, NGC 2068, NGC 7023, and IC 1287 in an attempt to detect continuous fluorescence by dust grains. Several effects of importance for observations of such faint objects are discussed, including instrumental light scattering, a photographic effect, and a time-delay effect which can occur if the illuminating star is a spectrum variable. It is found that continuous fluorescence by interstellar grains is not likely to exist and that it cannot account for more than 10% of the total surface brightness of these reflection nebulae. No evidence of diffuse interstellar features is found in the spectra of these nebulae. (auth)

23765 ALBEDO OF PARTICLES IN REFLECTION NEBULAE. Rush, W.F. (Ritter Astrophysical Research Center, The University of Toledo, Toledo, Ohio 43606). Astron. J. 80: No. 1, 37-44 (Jan 1975).

The relation between the apparent angular extent of a reflection nebula and the apparent magnitude of its illuminating star derived by Hubble (1922) has been reconsidered under a less restrictive set of assumptions. A computational technique has been developed which permits the use of fits to the observed m-log a values to determine the albedo of particles composing reflection nebulae, providing only that a phase function and average optical thickness are assumed. Multiple scattering, anisotropic phase functions, and illumination by the general star field are considered, and the albedo of reflection nebular particles appears to be the same as that for interstellar particles in general. The possibility of continuous fluorescence contributions to the surface brightness is also considered. (auth)

23766 SHORT-TERM RADIO VARIABILITY IN THE COMPACT GALAXY III Zw 2. Huchtmeier, W. K.; Wright, A. E. (CSIRO, Sydney). Astrophys. Lett.; 15: No. 4, 209-210(Dec 1973).

The variability in the radio emission of the compact galaxy III Zw 2 is reported. Flux density measurements were taken at frequencies of 160, 2700, 5000, 8870, and 9860 MHz, over a period of nine months with the Parkes 64-m radio telescope and the Culgoora radioheliograph. (auth)

23767 OBSERVATIONS OF OH IN NGC 4945 AND NGC 253. Whiteoak, J. B.; Gardner, F. F. (CSIRO, Sydney). Astrophys. Lett.; 15: No. 4, 211-215(Dec 1973).

OH absorption at 1665 and 1667 MHz has been detected against the nuclei of the edge-on galaxies NGC 4945 and NGC 253. For NGC 4945 the strongest absorption (at 1667 MHz) has a width of 300 km sec^{-1} and the peak optical depth (0.3) occurs at a velocity 40 km sec^{-1} higher than the systemic velocity. For NGC 253, the absorption is weaker—at 1667 MHz the peak optical depth is 0.07 at a velocity 50 km sec^{-1} below the systemic velocity. There may be a narrow-band (30 kHz) emission at 1665 and 1667 MHz; if so, it possibly results from maser amplification of the bright nuclear source. (auth)

23768 MOLECULAR HYDROGEN CONTENT OF LOW-DENSITY INTERSTELLAR CLOUDS. Glassgold, A. E.; Langer, W. D. (Nordiat, Copenhagen). Astrophys. Lett.; 15: No. 4, 199-202 (Dec 1973).

The abundance and distribution of molecular hydrogen for interstellar clouds with $A_v < 1$ were calculated using an extension of the work of Hollenbach, Werner, and Salpeter. The density, temperature, and abundances of H_2, H, C I, C II were obtained from appropriate equilibrium balance equations as a function of distance into the cloud. The fractional column density of hydrogen in molecular form f ranges over at least 4 or 5 orders of magnitude, in qualitative agreement with the results of Hollenbach et al. An upper limit of $\sim 4 \times 10^{-16}$ sec^{-1} can be placed on the cosmic-ray ionization rate; otherwise the high values of f observed by OAO-3 would not be achieved, owing to H_2 destruction by cosmic-ray ionization. (auth)

23769 DETERMINATION OF ELECTRON DENSITY IN INTERSTELLAR CLOUDS FROM $N(Ca^0)/N(Ca^+)$. Frisch, P. C. (Univ. of California, Berkeley). Astrophys. Lett.; 15: No. 4, 185-187 (Dec 1973).

The percentage concentrations λ of Ca^0 and Ca^+ were calculated as a function of optical depth within a uniformly dense cloud under the influence of an interstellar radiation field attenuated by $e^{-\tau\lambda}$. The common assumption that the two ionization species are coexistent within the cloud is shown to be unjustified in general, since the radius at which $n(Ca^+)$ falls to one-half of its central value is not the same as the radius at which $n(Ca^0)$ falls to one-half of its central value. A standard method for determining interstellar electron densities must therefore be applied with discretion. It is also shown that the ratio $N(Ca^0)/N(Ca^+)$, and therefore the deduced electron density, is relatively insensitive to the uncertain assumptions about the far-ultraviolet parameters. (auth)

Cosmology

Refer also to abstracts 23735 and 24576.

23770 OBSERVATIONAL ASPECTS OF LOCALLY INHOMOGENEOUS COSMOLOGICAL MODELS. Dyer, C. C. Toronto; Univ. of Toronto (1973). vp. National Library of Canada, Ottawa.

Thesis.

The observational consequences of a locally inhomogeneous mass distribution, on the scale of galaxies for example, in a model of the universe which is homogeneous and isotropic on some sufficiently large scale are considered. The analysis is in the geometric-optics approximation using the optical scalar equations for the two relevant optical scalars, i.e., the rate of expansion and rate of shearing of a beam of light. (WDM)

23771 VIRIAL THEOREM IN GENERAL RELATIVITY IN THE POST-NEWTONIAN APPROXIMATION. Kurmakaev, Z. Kh. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 8: 3-8(1967). (In Russian).

The virial theorem in general relativity in the post-Newtonian approximation for a system of rotating bodies with spherical symmetry is deduced. (auth)

23772 MASSIVE SPHERES WITH TWO CONSTANT-DENSITY INNER LAYERS AND A VARIABLE DENSITY OUTER LAYER IN GENERAL RELATIVITY. Krori, K. D.; Borgohain, P. (Cotton Coll., Gauhati, India). Indian J. Pure Appl. Phys.; 12: No. 9, 616-621(Sep 1974).

Two classes of spheres with three density distributions are considered in general relativity. Each of them has a constant-density core, a constant density intermediate shell and a variable density outer shell. Tolman's solutions V and VI of Einstein's equations are used to describe the outer variable density layer in the two

cases. The solution due to Mehra et al. [Phys. Rev., 186 (1969), 1333] is used to describe the constant-density layers. Conditions under which these spheres may become physical are discussed. Astrophysical implications of these deductions are also pointed out. (auth)

23773 UPPER LIMIT ON PHOTON–PHOTON INTERACTION FROM PHYSICAL COSMOLOGY. Puget, J. L.; Schatzman, E. (Observatoire de Paris, Section de Meudon, 92 (France). Dept. d'Astrophysique Fondamentale). Astron. Astrophys.; 32: No. 4, 477-478(Jun 1974).

It is shown that, if the microwave background has been emitted as black body radiation, enough is known about its spectrum to put upper limits on photon–photon interaction relevant to the problem of the origin of redshifts. (auth)

23774 CONFORMAL ENERGY–MOMENTUM TENSOR IN CURVED SPACETIME: ADIABATIC REGULARIZATION AND RENORMALIZATION. Fulling, S.A.; Parker, L. (Physics Department, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin 53201); Hu, B.L. Phys. Rev. D 10: No. 12, 3905-3924 (15 Dec 1974).

In preparation for an investigation of whether field–theoretic effects helped to make the early universe isotropic, we seek to determine the physical (divergence–free) energy–momentum tensor through which the geometry of spacetime is influenced by a quantized scalar field with conformal ("new improved") coupling to the metric. The cosmological models studied are the Kasner–like (type I) metrics (homogeneous, spatially flat, nonrotating, but anisotropic), and also the isotropic Robertson–Walker metrics. The methods employed have previously been expounded in the context of a minimally coupled scalar field and a Robertson–Walker metric. Three divergent leading terms are extracted from an adiabatic expansion of the formal expressions for the expectation values of the energy density and pressures. In the Kasner case a slight reshuffling of the leading terms in the energy density displays all divergences to be proportional to either the metric tensor or a second–order curvature tensor which vanishes when the spacetime is isotropic; hence a finite energy–momentum tensor remains after renormalization of the cosmological constant and one other coupling constant in a generalized Einstein equation. In the Robertson–Walker cases, because of conformal flatness, there is no divergence beyond the usual quartically divergent constant vacuum energy; when the mass is not zero, however, a finite renormalization of the gravitational constant is suggested. The correctness of the methods is tested by considering a coordinate system in which flat spacetime assumes the form of a Kasner universe: The adiabatic definition of particle number and vacuum, which is basic to our expansion and renormalization methods, is seen to be consistent with the usual flat–space concepts. (auth)

23775 REGGE-CALCULUS MODEL FOR THE TOLMAN UNIVERSE. Collins, P. A.; Williams, R. M. (Department of Mathematical Physics, University of Birmingham, P. O. Box 363, Birmingham, B15 2TT, England). Phys. Rev., D; 10: No. 10, 3537-3538(15 Nov 1974).

23776 OBSERVATIONAL CONSEQUENCES OF A "DOMAIN" STRUCTURE OF THE UNIVERSE. Everett, A.E. (Department of Physics, Tufts University, Medford, Massachusetts 02155). Phys. Rev. D 10: No. 10, 3161-3166 (15 Nov 1974).

It has been suggested that the spontaneously broken gauge symmetries, recently postulated in connection with unified theories of weak and electromagnetic interactions, might have the symmetry restored at sufficiently high temperatures, in analogy with the spontaneously broken rotational invariance in a ferromagnet. Weinberg has also raised the possibility that, in cooling from the "big bang," the universe might have developed spatial "domains" with different preferred directions in charge space. We consider possible observational consequences of such a structure, particularly in terms of observations on electromagnetic radiation from astronomical sources. We find that a discontinuous boundary between such domains would act as a perfect mirror, reflecting all incident electromagnetic radiation. If the transition between domains is smooth, with a transition region whose thickness is large compared with a wavelength of the incident radiation, there is no reflection and one observes a transmitted wave identical to the incident wave. (auth)

23777 INERTIAL EFFECTS IN THE GRAVITATIONAL COLLAPSE OF A ROTATING SHELL. Lindblom, L.; Brill, D.R. (Physics Department, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 10, 3151-3155 (15 Nov 1974).

Inertial dragging effects of slowly rotating masses in asymptotically flat spaces are well known for the case of a stationary distribution of matter. In the present work we investigate a more general example in which angular acceleration of the matter is present. We solve the Einstein field equation for the case of the free–fall collapse of a rotating dust shell. The solution is exact, through terms of first order in ω (the angular velocity of the shell), for shells of arbitrary rest mass and radial velocity. The inertial properties of the flat interior region of this solution are discussed. Among the problems elucidated by this solution is the question of whether the inertial effects are instantaneous or retarded as viewed from infinity. (auth)

23778 STEPS TOWARD THE HUBBLE CONSTANT. IV. DISTANCES TO 39 GALAXIES IN THE GENERAL FIELD LEADING TO A CALIBRATION OF THE GALAXY LUMINOSITY CLASSES AND A FIRST HINT OF THE VALUE OF H_0. Sandage, A.; Tammann, G.A. (Hale Observatories, Carnegie Institution of Washington). Astrophys. J. 194: No. 3, 559-568 (15 Dec 1974).

Distances to 39 late–type (Sc–Sd–Sm–Ir) field galaxies have been obtained from the sizes of their H II regions as measured on red–sensitive plates taken with the Mount Wilson and the Palomar reflectors. The distances follow from the calibration in Paper I, and are combined with apparent magnitudes to give absolute magnitudes. The sample is increased to 48 galaxies by adding members of the Local and NGC 2403 groups, whose distances are known from Cepheids. The distribution of absolute magnitudes among the van den Bergh luminosity classes (L_c) is determined, and a new absolute calibration of the mean total galaxian luminosity with luminosity class is obtained. The derived $\langle M_{pg}{}^{a,i}\rangle = f(L_c)$ relation is tested for shape by comparing it with the relative calibration for Virgo cluster spirals of different L_c, and with van den Bergh's initial calibration that used the ratio of redshifts to obtain relative distances of field galaxies in Humason, Mayall, and Sandage. The adopted absolute magnitudes, combined with the apparent magnitudes of Virgo cluster spirals, gives the distance to the Virgo cluster as $(m-M)_0 = 31.45 \pm 0.09$, or $D = 19.5 \pm 0.8$ Mpc. Two methods (the Hubble diagram for first–ranked E galaxies in clusters, and the color–magnitude relation for E galaxies in the Coma cluster compared with Virgo) show that the Virgo cluster has no detectable peculiar velocity. The systemic velocity is $\langle v_0 \rangle = 1111 \pm 75$(rms) km s^{-1}. This, combined with D, gives a first hint at the value for the Hubble constant as $H_0 = 57 \pm 6$ km s^{-1} Mpc^{-1}. The value agrees well with that obtained in Paper VI which follows, where many field spirals are used at large redshifts beyond any possible local velocity anisotropy. The value of H_0 obtained here via the Virgo cluster depends not on the data for the Virgo cluster alone, but on the total statistical sample of 84 brightest E galaxies that make up the Hubble–diagram formulation for clusters. (auth)

23779 AN UNBOUND UNIVERSE. Gott, J. R. III; Gunn, J. E.; Schramm, D. N.; Tinsley, B. M. (California Institute of Technology). Astrophys. J.; 194: No. 3, 543-553(15 Dec 1974).

A variety of arguments strongly suggest that the density of the Universe is no more than a tenth of the value required for closure. Loopholes in this reasoning may exist, but if so, they are primordial and invisible, or perhaps just black. (auth)

23780 GALAXY COUNTS AS A COSMOLOGICAL TEST. Brown, G.S. (The University of Arkansas at Little Rock); Tinsley, B.M. Astrophys. J. 194: No. 3, 555-558 (15 Dec 1974).

Analytical approximations and numerical calculations are given for the number–magnitude relation for galaxies. It is shown that this relation is no more sensitive to the cosmological model (in particular, to the value of q_0 in the standard Friedmann models without cosmological constant) than to effects of galactic evolution and possible intergalactic absorption. Counts are expected to be dominated by spiral galaxies. The number–magnitude relation is thus not a straightforward cosmological test, since its interpretation will require a good knowledge of the luminosity functions, spectra, and evolution of all types of galaxies. (auth)

23781 CAN THE CONSTRAINT OF FINITE MASS SMOOTH FLUCTUATIONS IN THE BACKGROUND RADIATION?. Schwartz, D.A. (Center for Astrophysics, Harvard College Observatory/Smithsonian Astrophysical Observatory). Astrophys. J. Lett. 194: No. 3, L139-L142 (15 Dec 1974).

In principle, the fact that only a finite amount of mass is availabe to create discrete sources of radiation, causes the small–scale fluctuations due to unresolved sources to be smoother than that predicted from Poisson statistics. We point out here that this effect is significant only when an appreciable fraction of all the mass goes into creating such sources. This places significant constraints on models in which the X–ray or microwave background is composed of unresolved discrete sources of number density much less than required by Poisson statistics. However, it allows reconciliation of the apparent inconsistency between the number of high–latitude Uhuru sources and X–ray background fluctuations. The high–latitude sources might uniformly fill space with a density as high as 10^{-6} Mpc^{-3} and a mean luminosity as low as 5×10^{44} ergs s^{-1}. (auth)

23782 THE PRIMORDIAL GENERATION OF RANDOM SHEAR MOTIONS AND SMALL–SCALE ANGULAR ANISOTROPY IN THE MICROWAVE BACKGROUND RADIATION. Silk, J. (Department of Astronomy, University of California, Berkeley). Astrophys. J. 194: No. 2, 215-222 (1 Dec 1974).

Density fluctuations in the early Universe generate random shearing motions via their nonlinear gravitational interactions. The magnitude of

the residual shear flow at the present epoch can amount to $\sim q_0^2 H_0$ over scales of up to ~30 Mpc. The associated primeval adiabatic and shear-generated temperature fluctuations of the microwave background radiation are calculated in the presence of a scattering medium. Current observational results on small-scale (2'-20') angular anisotropies in the microwave background radiation are shown to impose severe constraints on the deceleration parameter q_0 independently of whether rescattering by an ionized intergalactic plasma is assumed to weaken the primeval temperature fluctuations, since the shear motions are found to generate fluctuations of comparable magnitude on the surface of last scattering. In particular, two recent upper limits on temperature fluctuations require that q_0 must exceed 0.03 (Carpenter et al.) or 0.1 (Parijskij). (auth)

23783 STEPS TOWARD THE HUBBLE CONSTANT. III. THE DISTANCE AND STELLAR CONTENT OF THE M101 GROUP OF GALAXIES. Sandage, A.; Tammann, G.A. (Hale Observatories, Carnegie Institution of Washington.). Astrophys. J. 194: No. 2, 223-243 (1 Dec 1974).

The distance to M101 and its five late-type companions (NGC 5204, 5474, 5477, 5585, and Ho IV) is obtained by six methods from new data on the stellar content, after the reality of the group is tested using criteria of adjacency, resolvability, redshifts, and dynamical stability. The brightest stars in M101 are isolated and measured relative to a new photometric sequence that covers the range $12.6 < B < 21.7$. Analysis of the color-magnitude diagram shows the brightest resolved blue star in M101 to have B=18.97. Correction of older data suggests B(3) =20.6 for NGC 5474, and B(3) = 20.9 in NGC 5585. Despite a serious study, no red supergiant variables with $B - V > 2.0$ were found in M101 brighter than a limit of V=21. Further, after a thorough search, no Cepheids were found brighter than a limit of B = 22.5. Eight irregular blue variables were isolated from the total plate material that extends from 1909 to the present. From these data, and from the largest H II regions in the six group members, the distance is calculated to be $D = 7.2 \pm 1$ Mpc, or $(m-M)_0 = 29.3 \pm 0.3$ which is more than 10 times that adopted by Hubble in 1936. This result forms the basis for extending the calibrations of H II regions and of stars in Papers I and II of this series to the Sc I galaxies so that the distance scale can be carried outward into the general field (Papers IV and VI) The velocity-distance ratio for the M101 group alone, obtained from the adopted distance and from $\langle v_o \rangle = 402 \pm 4.2$ km s^{-1} (and allowing 30 km s^{-1} mean random motion for the group [Paper V] in the error calculation), is $v/r = 55.5 \pm 8.7$ km s^{-1} Mpc, which agrees well with the global value of the Hubble constant itself (Paper VI), showing the lack of measurable perturbation of the Hubble expansion flow at M101 (cf. Paper V). (auth)

23784 QUASAR-CLUSTER ASSOCIATION AS A TEST OF THE COSMOLOGICAL OR LOCAL HYPOTHESIS. Bell, M.B. (Astrophysics Branch, National Research Council of Canada). Astrophys. J. 194: No. 2, 245-248 (1 Dec 1974).

It is pointed out that QSOs are likely to be superluminous objects only if their redshifts are cosmological. For local models in which a large fraction of the redshift is attributed to some other cause, they are more likely to be subluminous. Unbiased searches for quasar-cluster associations should give predictable and remarkably different results for real associations in each model. It is suggested that local quasar theories might be useful in determining whether or not quasar-cluster associations are real. Quasar distances, estimated using a method described by Bell and Fort, are compared with the cluster distances estimated for the quasar-cluster associations found by Bahcall and by Bahcall, Bahcall, and Schmidt. Reasonable agreement is found for 16 out of the 22 cases. (auth)

23785 OBSERVED DEFLECTION OF LIGHT BY THE SUN AS A FUNCTION OF SOLAR DISTANCE. Merat, P.; Vigier, J. P. (Paris-6 Univ., 75 (France). Inst. Henri Poincare); Pecker, J. C. (College de France, 75-Paris; Institut d'Astrophysique du CNRS, 75-Paris (France)); Yourgrau, W. (Denver Univ., Colo. (USA)). Astron. Astrophys.; 32: No. 4, 471-475(Jun 1974).

A detailed analysis using modern computing methods of all known measurements of the deflection of light near the solar limb shows the validity of Einstein's prediction beyond a certain distance of the sun and the possible existence of a new effect in the close vicinity of the solar limb which can be interpreted as resulting from a dispersive medium emitted by the solar surface. (auth)

23786 EFFECT OF A LINEAR ROTATIONAL PERTURBATION ON THE ISOTROPY OF THE COSMIC BACKGROUND RADIATION. Anile, A. M. (Univ. Calabria, Cosenza, Italy); Motta, S. Astron. Astrophys.; 32: No. 2, 137-139(May 1974).

The effect of a linear rotational perturbation of an Einstein-de Sitter universe on the anisotropy of the cosmic background radiation is investigated. The predicted temperature variations are compared with the observed upper limits (Conklin and Bracewell, 1968). In this way an upper limit to the angular velocity of the perturbation is obtained which is in disagreement with the suggested value for the Local Supercluster (de Vaucouleurs and Peters, 1968). However it is realized that the model is very crude, and that great care must be taken before drawing any conclusion about the nonexistence of rotating superclusters in the Universe. (auth)

23787 INTERSTELLAR ABSORPTION AND AN APPARENT ANISOTROPY IN THE HUBBLE EXPANSION. Hartwick, F.D.A. (University of Victoria). Astrophys. J. Lett. 195: No. 1, L7-L9 (1 Jan 1975).

Residuals from the magnitude-redshift relation for first ranked E and SO galaxies suggest a nonrandom distribution on the sky similar to the effect (though of smaller amplitude) recently found for ScI galaxies by Rubin *et al.* It is tentatively concluded that interstellar absorption in a large region of the sky at galactic longitudes $90° \leq l \leq 200°$ is responsible for at least part of this effect. (auth)

Planetary Phenomena

23788 IMPLICATIONS OF THE PIONEER 10 MEASUREMENTS OF THE JOVIAN MAGNETIC FIELD FOR THEORIES OF IO-MODULATED DECAMETRIC RADIATION. Smith, R. A. (Goddard Space Flight Center, Greenbelt, M. D.; Wu, C. S. Astrophys. J., Lett.; 193: No. 2, L101-L102(15 Oct 1974).

23789 NON-STEADY SCHEME OF THE PLANETARY SYSTEMS. Omarov, T. B. Tr. Astrofiz. Inst., Akad. Nauk Kaz. SSR; 7: 26-31(1966). (In Russian).

The nonsteady scheme of the planetary systems is considered. The vector differential equations of this scheme are transformed to those of the oscillating elements of the aperiodic motions along the conical sections. The possibility partly to illustrate the evolution of these elements for some private mass variation law is discussed. (auth)

23790 SPECTRAL BEHAVIOR OF JUPITER NEAR 1 MHz. Brown, L.W. (Radio Astronomy Branch, Laboratory for Extraterrestrial Physics, Greenbelt, Maryland). Astrophys. J. Lett. 194: No. 3, L159-L162 (15 Dec 1974).

Emission from Jupiter has been observed by the IMP-6 spacecraft at 25 frequencies between 425 and 9900 kHz covering the period 1971 April to 1972 October. The Jovian bursts were identified through the phase of the observed modulated signal detected from the spinning dipole antenna. Approximately 500 days of data have been scanned for Jupiter emissions with a positive detection of at least 382 events. The static spectral behavior of the emission has been investigated and can be divided naturally into three types. Type one (normal) shows a high correlation with Earth-based observations and follows the same spectral behavior. These bursts are seldom detected much below 1 MHz. The second type (md-frequency) occurs near or below 1 MHz and shows low- and high-frequency cutoffs. The emission peak is near 900 kHz with a 3 db bandwidth of approximately 450 kHz. A third type consists of a complex combination of the previous types. (auth)

23791 JUPITER: A COMMENT ON THE 8- TO 14-MICRON LIMB DARKENING. Trafton, L. (Department of Astromony and The McDonald Observatory, The University of Texas at Austin); Wildey, R. Astrophys. J. 194: No. 2, 499-502 (1 Dec 1974).

Recent laboratory measurements have yielded directly most of the parameters of a band model which describes the mean transmission of NH_3 diluted in H_2. Greenhouse models employing H_2, He, and saturated NH_3 explain both Jupiter's net thermal flux and the 8- to 14-μ limb darkening without invoking a temperature inversion in the layers responsible for this band emission. The results are not yet precise enough to yield accurate He/H_2 ratios from observation of the brightness temperature at the center of the disk. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

23792 ATTEMPT TO DETECT THE EFFECTS OF COSMIC GAMMA-RAY BURSTS IN THE LOWER IONOSPHERE. Kasturirangan, K. (Indian Inst. of Science, Bangalore); Reo, U. R.; Sharma, D. P.; Rastogi, R. G.; Chakravarti, S. C. Nature (London); 252: No. 5479, 113-114(8 Nov 1974).

A search was made for effects of γ-ray bursts on vlf propagation characteristics in the D region of the ionosphere, using data on field strength variations recorded at Ahmedabad corresponding to 164 kHZ transmissions from Tashkent. The method of examination depended on measurements of the field strength of vlf propagations showing absorption corresponding to the transit times of x-ray emitting celestial bodies due to the resulting enhanced ionisation in the lower ionosphere. Results of the search are shown tabulated - careful search showed no observable field strength variations associated with the bursts, suggesting that the x rays from the events did not have any significant influence on the ionisation of the D region. The electron production rates in the D region for a typical event were also estimated, and results are again shown tabulated. A striking feature was that the altitude at which the maximum rate of ionisation occurred was about 70 km, compared with 85 km for Sco X-1. This is related to the high values of recombination coefficients at lower altitudes. It is concluded that for the type of bursts so far detected the ionospheric effects are too weak to cause observable perturbations in vlf propagation. (UK)

23793 ATMOSPHERIC GRAVITY WAVES: THEIR EFFECTS ON IONOSPHERIC TEMPERATURE AND COMPOSITION. Pradad, S. S.; Furman, D. R. (Univ. of Florida, Gainesville). J. Atmos. Terrest. Phys.; 37: No. 1, 17-30(Jan 1975).

A model study of the response of the lower F-region electron temperature T_e, to the passage of atmospheric gravity waves has been made. It was found that the perturbation in T_e is usually of the same order as the perturbation in T_n. This is understandable in view of the fact that the perturbation in production rate and, thereby, in heat input was mostly in phase with the changes in N_e. This meant that higher heat input was associated with a larger number of electrons to share it, in such a way that the changes in T_e remained close to the changes in T_n. Gravity wave induced changes in the ion-composition, $n(O^+)/N_e$, were also investigated in the context of the radar backscatter determination of thermospheric temperature waves using the double pulse technique. Long period waves ($\tau \sim$ 4hr) with moderate energies (atmospheric motions $\simeq$ 45 m/sec) may influence the temperature determination, irrespective of the azimuth of their propagation. The extent of the influence will depend upon the sensitivity of the autocorrelation function to the ion composition. For shorter period waves ($\tau \approx$ integration time), however, the wave induced composition changes may have to be taken into account only when the wave is propagating in one of the preferred azimuths. (auth)

23794 MORPHOLOGY AND FINE TIME STRUCTURE OF AN EARLY-MORNING ELECTRON PRECIPITATION EVENT. Trefall, H. (Univ., Bergen); Ullaland, S.; Stadsnes, J. J. Atmos. Terrest. Phys.; 27: No. 1, 83-105(Jan 1975).

Simultaneous balloon recordings of auroral-zone x rays from precipitating electrons, covering a range of L-values from $\approx$5 to $\approx$7.5, are presented. The precipitation event was observed in the early morning sector (from about 0200 to 0500 local magnetic time), and was associated with a negative magnetic bay. Before the bay, precipitation associated with the growth phase of the substorm was observed at high L-values. After bay onset, precipitation was observed over the whole range of L-values covered, but with a delayed onset in the southern part of the precipitation region as compared with the onset of cosmic noise absorption in the local midnight sector. At high L-values the x-ray flux was completely unstructured and drizzle-like, both before and after bay onset. At low L-values, where precipitation occurred only after bay onset, the event was splash-like with x-ray bursts of typically 4 to 6 sec duration apparently rising out of the cosmic-ray background. The precipitation bursts had spatial extensions of 300 to 400 km. They were accompanied by weak magnetic impulses which were, both temporally and spatially, closely related to the x-ray bursts. The unstructured precipitation at high L-values was apparently associated with and extending along the auroral electrojet, presumably representing freshly accelerated particles. The highly structured and burst-like precipitation to the south seems to have come from a cloud of electrons drifting out from the acceleration region, from which wave-particle instabilities or some other mechanism caused electrons to be precipitated. (auth)

23795 PHYSICS OF MESOSPHERIC (NOCTILUCENT) CLOUDS. Proceedings of the Conference Held at Riga, USSR, November 20-23, 1968. Ikaunieks, J. (ed.). Portland, OR; International Scholarly Book Services, Inc. (1973). 164p. (CONF-681145-; ISBN-0-7065-1373-8). $16.00.

Twenty-two papers dealing with problems connected with the study of noctilucent clouds were presented. (WDM)

23796 BULK RESULTS OBTAINED FROM ARCAD EXPERIMENT ABOARD AUREOLE SATELLITE. Cambou, F. (Univ., Toulouse); Galperin, Yu. I. Ann. Geophys.; 30: No. 1, 9-19(Jan 1974). (In French).

The ARCAD experiment aboard the satellite AUREOLE, launched December 27, 1971 (apogee: 2500 km; perigee: 410 km; tilt 74 deg), is made up of a complex system of complementary experiments directed at finding a large-scale interpretation of auroral phenomena. This project has clarified several ideas about the size and shape of the polar cusp; also the magnetic flux within the magnetosphere during a quiet geomagnetic period, and the potential difference across the magnetosphere have been estimated. This experiment also made it possible to define the specific characteristics of auroral proton precipitations. These precipitations seem to involve complex changing processes, even during the quiet phase. Studying these processes entails analyzing a variety of simultaneous satellite and ground data. (FR)

23797 SIMULTANEOUS OBSERVATION OF FADING RATES ON TWO TRANSEQUATORIAL HF RADIO PATHS. Carman, E. H. (Univ. of Botswana, Swaziland); Heeran, M. P.; Roettger, J. Aust. J. Phys.; 27: No. 5, 741-744(Oct 1974).

Fading rates of transequatorial h.f. signals are evaluated from observations on the paths Lindau-Roma and Tsumeb-Lindau which cross the equatorial zone of Africa. The fading characteristics on both paths are shown to be correlated. A comparison with transequatorial pulse transmission, which indicates off-great-circle propagation due to spread-F irregularities, gives evidence for a high correlation between the fading of c.w. signals propagating on transequatorial paths and the occurrence of off-great-circle propagation due to equatorial spread-F irregularities. (auth)

23798 PLASMA CONVECTION IN POLAR IONOSPHERE. Galperin, Yu. I.; Ponomarev, V. N.; Zosimova, A. G. (Inst. of Space Research, Moscow). Ann. Geophys.; 30: No. 1, 1-7(Jan 1974).

The vertical and horizontal components of the ionospheric plasma convection velocity at 630 km altitude were measured from the polar circular orbit of the Cosmos-184 satellite in October-November, 1967, from the thermal ion flow asymmetry with respect to the satellite's velocity vector; the errors in this measurement were less than $\pm$0.4 km/sec. The convection pattern above the auroral ovals is roughly consistent with the results obtained from the OGO-6 satellite. The electric field at the day polar cusp either diverges to or converges from higher or lower latitudes, but simultaneous patterns in the northern and southern cusps are strinkingly different. During the most intense breakup of the storm on November 3, 1967, a jet was formed, oppositely directed to the growing and bifurcating westward electrojet, at its equatorward edge. This is interpreted as polarization due to anomalous parallel resistivity. The persistence of the banded convection pattern above nonsunlit polar cap after the storm testifies to the slow relaxation of the tail pressure gradients normal to neutral sheet (or of waves propagating upstream the tail). It was discovered that the features causing these inhomogeneities and reversals in the drift pattern originated at, or close to, the polar side of the dayside auroral oval and hence close to the surface of the tail lobe (i.e., at the magnetopause), and than gradually sank to the core of the tail lobe and further to the plasma sheet. The time rate of the antisunward displacement of this inhomogeneous drift pattern above the dark northern Polar Cap if transformed to the new magnetic tail coordinate, the magnetic depth introduced by Morfill, (1972), makes it possible to deduce average cross-tail electric field and, if the solar wind speed is available from other data, also the tail length in reasonable agreement with other existing estimates. (FR)

23799 TRAVELLING IONOSPHERIC DISTURBANCES AND IONIZATION DIFFUSION. Broche, P. (Centre Univ., Toulon, France); Nicollet, M. Ann. Geophys.; 30: No. 1, 71-77(Jan 1974). (In French).

Coupling between the movement of ionized particles and neutral particles due to a medium scale travelling disturbance in the F region and middle latitudes is studied with particular attention to the effects of ionization diffusion. With several models of perturbations, it is shown that the diffusion does not considerably modify the coupling properties but sometimes may magnify variations of electron density. A physical interpretation of the mechanism is given. (FR)

23800 THEORY OF F REGION RECOMBINATION PROCESSES. Van Zandt, T. E. (National Oceanic and Atmospheric Administration, Boulder, CO); Tinsley, B. A. Ann. Geophys.; 30: No. 1, 21-30(Jan 1974).

Recent developments in the theory of the three F-region recombination processes (dissociative recombination, radiative recombination, and ion–ion recombination) are discussed. (FR)

23801 EQUATORIAL RECOMBINATION EMISSIONS AND THE APPLETON ANOMALY. Hicks, G. T.; Chubb, T. A. (Naval Research Lab., Washington, DC). Ann. Geophys.; 30: No. 1, 31-42(Jan 1974).

The behavior of emissions due to radiative recombination and dissociative recombination in the region of the Appleton anomaly are discussed. These emissions can be used as a way of remotely sensing F-region plasma properties, and the winds responsible for plasma transport. (FR)

23802 TROPICAL AIRGLOW. Kulkarni, P. V. (Physical Research Lab., Ahmedabad, India). Ann. Geophys.; 30: No. 1, 105-115(Jan 1974).

During the last few years many authors' studies were reported on the tropical airglow. Works were summarized in the following areas: (a) newly detected emissions, (b) the reactions responsible for these emissions and the rates of reactions, (c) dynamical processes observed in night airglow by satellite-borne and ground-based experiments and their interpretations, (d) dependence of some radiations on magnetic activity, solar flares etc. It must be noted that many airglow emissions in the tropics (±25 deg latitude) show entirely different behavior in intensity variations compared to those on the magnetic equator. (FR)

23803 SEASONAL VARIATIONS OF THE APPEARANCE OF TWO MAGNETIC-ION COMPONENTS IN THE E LAYER. Serafimov, K. B.; Pashova, Z. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 7, 921-924(1974).

The main task of this study is to explain as far as possible the seasonal variations of the appearance of both magnetic-ion components in the E region by analyzing the following characteristic values: (i) seasonal variations in the position of the maxima in the daily variations of the appearance of the X component; (ii) seasonal variations of the magnitude of these maxima; and (iii) seasonal variations with the appearance of both components at a constant zenith angle of the Sun. (WDM)

23804 DIFFUSE RADAR AURORA: SPECTRAL OBSERVATIONS OF NON–TWO–STREAM IRREGULARITIES. Greenwald, R.A.; Ecklund, W.L.; Balsley, B.B. (Aeronomy Laboratory, Environmental Research Laboratories, NOAA, Boulder, Colorado 80302). J. Geophys. Res. 80: No. 1, 131-140 (1 Jan 1975).

Since the two–stream instability was identified as the source of one type of electron density irregularity that is found in the equatorial electrojet, a number of people have suggested that this instability is also responsible for diffuse radar aurora. Consequently, there have been a number of attempts to observe two–streamlike spectra in diffuse radar auroral backscatter. To date, these attempts have produced mixed results. In this paper we review these past spectral studies and present some recent spectra observations of 3–m irregularities (50–MHz radar) that were made from Anchorage and Aniak, Alaska. Our observations indicate the presence of two distinct spectral components, both of which have a number of non–two–stream characteristics. Namely, they have an azimuth–dependent mean Doppler shift that approaches zero when the radar is directed perpendicular to the electrojet current. The broader spectral component, which we observe, has a typical width of 400 Hz, whereas the narrow component has a width of less than 150 Hz. The narrow component often displays a double–peaked structure with a peak separation of 30–60 Hz. Since these spectral observations were made at angles within 30° of perpendicular to the electrojet current vector and since primary two–stream or gradient drift irregularities are preferentially excited in the direction of the electron current vector, we conclude that our observations are of secondary irregularities generated from the primary irregularities and that these irregularities are more likely due, directly, to the gradient drift instability than to the two–stream instability. Recent theoretical studies of small–scale irregularity generation in the diffuse radar aurora support this contention. (auth)

23805 PARALLEL PROPAGATION EFFECTS ON THE TYPE 1 ELECTROJET INSTABILITY. Ossakow, S.L.; Papadopoulos, K.; Orens, J.; Coffey, T. (Naval Research Laboratory, Washington, D.C. 20375). J. Geophys. Res. 80: No. 1, 141-148 (1 Jan 1975).

The Farley–Buneman instability has been extended to consider higher–frequency shorter–wavelength modes (thus including finite Debye length effects), and these modes are allowed to propagate with a component parallel to the magnetic field ($k \neq 0$). When the current is driven sufficiently hard (drift speeds in the range 2–3 times the ion thermal velocity v_i), the growth rate of these modes maximize slightly away from the perpendicular to the magnetic field, and thus the importance of $k \neq 0$ is shown. Although the wavelengths of these maximum growing modes are in the regime of tens of centimeters, the phase velocities are closer to the ion thermal velocity than those modes propagating at 90° ($k=0$). Maximum growth rates of off–angle propagation for different densities and collision frequencies are shown. Also, growth rates of unstable waves in the radar regime (1–10 m) are shown for drift velocities 1.5 v_i and 3 v_i. These also maximize with $k \neq 0$ and have phase velocities closer to v_i than they have for purely perpendicular propagation. In all cases considered the phase velocity of the waves is a rapidly decreasing function of angle as one moves away from pure perpendicular propagation. (auth)

23806 CONVERSION OF AN ION-ACOUSTIC WAVE BY COLLISIONS TO A NEUTRAL SOUND WAVE IN A NON-HOMOGENEOUS PLASMA. Pian, C. C. P. Ann Arbor, MI; Univ. of Michigan (1974). 83p. University Microfilms Order No. 75-778.

Thesis (Ph. D.).

The collisional coupling of low frequency ion-acoustic waves and neutral sound waves propagating downward in the ionosphere is investigated. The ionosphere is considered as a non-homogeneous weakly ionized plasma consisting of electrons, ions and neutrals. The equations of conservation of mass, momentum, and energy of the three species constitute the basic equations for the analysis. The plasma is assumed to be electrically neutral. Collisional energy transfer between the hot electrons and the colder neutrals is taken into account. The coupled differential equations for the wave amplitudes are solved analytically. The solution yields an expression for the amplitude of the neutral sound wave at low altitudes. Results showing the behavior of the neutral amplitude as a function of wave frequency and distance from the ionosphere-neutral atmosphere interface for different temperature ratios and different scale heights are presented. (Diss. Abstr. Int., B)

Magnetospheric Phenomena

Refer also to abstract 23653.

23807 (BNWL-SA-4953) HYDROMAGNETIC-WAVE STRUCTURE OF TOROIDAL MODES IN THE MAGNETOSPHERE. Liemohn, H. B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-1830. 47p. (CONF-741015-10). Dep. NTIS $5.50.

From 21st national symposium of the American Vacuum Society; Anaheim, California, USA (19 Oct 1974).

An analytic eigenmode description of hydromagnetic wave energy in the magnetosphere has been obtained for realistic cavity models. Although the general hydromagnetic wave equation is exceedingly complicated, it can be simplified enormously without losing essential quantitative features. Under steady-state conditions most of the electromagnetic energy is believed to reside in the toroidal mode, which is characterized by field-line propagation of a meridional electric field. The differential equation for this mode in dipole coordinates is closely approximated by a general form of Bessel's equation, which allows a four-parameter fit to quantitative models of the rapidly varying wave number. Values of the wave-number parameters place the Bessel solution in the asymptotic regime where closed form analytic expressions are available for the eigenvalues and eigenfunctions. Since the wave number approximation is exceptionally close, the Bessel eigenmodes are expected to provide a good approximation for the solution of the original problem. The effects of a variable phase velocity and geomagnetic convergence are clearly discernible in the analytic expressions for the amplitude and phase of each mode. The azimuthally symmetric mode has entirely transverse wave fields which are linearly polarized with complicated phase structure. The asymmetric modes, on the other hand, have a significant portion of their magnetic-wave energy in the component aligned with the geomagnetic field. As a consequence of these properties, the wave structure observed by satellites may be expected to differ appreciably from that observed on the ground. However, if these hydromagnetic eigenmodes can be isolated experimentally in geomagnetic pulsation spectra, the observed wave-envelope properties could provide vital diagnostics of magnetosphere activity and solar wind flux. (auth)

23808 PARTICLE DIFFUSION IN THE RADIATION BELTS. Schulz, M.; Lanzerotti, L. J. Physics and Chemistry in Space, Volume 7. New York; Spriger-Verlag New York, Inc. (1974). 146p. $32.00.

The dynamics of particles in the Earth's radiation belts and the stochastic processes that lead to a diffusion of the particle distributions with respect to the adiabatic invariants are explained. Adiabatic invariants and magnetospheric models are discussed in terms of action-angle variables, the Liouville theorem, dipole fields, distorted fields, flux mapping, and shell tracing. Pitch-angle diffusion and radial diffusion, collisions, wave-particle interactions, bounce and cyclotron resonances, magnetic and electrostatic impulses, Bohm diffusion, shell splitting, and other types are examined in turn. The important prototype observations and their tabulated data are reported. Some methods of empirical analysis, including pitch-angle eigenmodes, quadrature, variational methods, and temporal and spatial integration, are described. (IAA)

23809 MAPPING OF THE PARTICLE CURRENT IN THE OUTER MAGNETOSPHERE. Kasimov, U. Dokl. Akad. Nauk Uzb. SSR; No. 7, 28-30(1974). (In Russian).

A method is described for the comparison of the value of the directional beam of particles obtained simultaneously at different points. The method eliminates the time variation of the magnetic field. (JSR)

23810 SATELLITE AND GROUND OBSERVATIONS OF MAGNETOSPHERIC VLF HISS ASSOCIATED WITH THE SEVERE MAGNETIC STORM ON MAY 25–27, 1967. Hayakawa, M.; Tanaka, Y.; Ohtsu, J. (Research Institute of Atmospherics, Nagoya University, Toyokawa, Aichi, Japan). J. Geophys. Res. 80: No. 1, 86-92 (1 Jan 1975).

The purpose of this paper is to make clear the characteristics of magnetospheric VLF hiss during storm times. The study is based on the VLF observations on board the Ariel 3 satellite as well as on the ground during the severe magnetic storm of May 25–26, 1967. Soon after the onset of the main phase there appeared the VLF hiss in the morning sector of the magnetosphere ('morning hiss') on the satellite as well as ground records, but the hiss is not observed in the evening sector. It was not until during the recovery phase that we could recognize the stationary occurrence of strong VLF hiss in the evening side of the magnetosphere ('evening hiss') The important features of the morning and evening hiss are described, and some discussions concerning their generation mechanism by the ring current particles are given. (auth)

23811 FAST HISSLERS IN SUBSTORMS. Siren, J.C. (Radioscience Laboratory, Stanford University, Stanford, California 94305). J. Geophys. Res. 80: No. 1, 93-97 (1 Jan 1975).

'Fast hisslers', or very brief bursts of auroral hiss dispersed in the whistler mode, have been found to occur in substorms at Byrd station, Antarctica. Broad band VLF data recorded on tape during breakup phases of substorms were monitored aurally. In two of 19 substorm breakup phases observed at Byrd station, fast hisslers were heard. The data were subsequently spectrum analyzed to permit measurement of whistler mode dispersion, from which the altitudes of their origin were estimated. Some of the fast hisslers exhibited a 'noise' or nonextremal frequency of earliest arrival. This feature permitted an estimate of altitude of origin that is nearly independent of the field line electron density distribution model. Altitudes of origin of 1800–30,000 km are deduced. Some fast hisslers have been observed at phases other than the breakup phase. Fast Fourier transform spectra show that fast hisslers are indistingusihable from dispersed short pulses of band–limited white noise. Incoherent Cerenkov radiation from precipitating auroral electrons is of insufficent intensity to account for this phenomenon. (auth)

23812 POLARIZATION CHANGES OF GEOMAGNETIC Pi 2 PULSATIONS ASSOCIATED WITH THE PLASMAPAUSE. Fukunishi, H. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Geophys. Res. 80: No. 1, 98-110 (1 Jan 1975).

The polarization characteristics of substorm–associated Pi 2 pulsations are studied in detail on statistical and nonstatistical bases by using magnetic data from a network of stations ($L=3.2-4.4$) along a geomagnetic meridian and a conjugate station ($L\sim4$) in the southern hemisphere. The predominant periods in the Pi 2 wave trains are usually constant at all latitudes, whereas the polarization characteristics of the predominant oscillations change drastically among the stations. That is, reversals of the sense of polarization between two stations were often observed. Such polarization reversals result from the latitude dependence of the wave phase: the *D* (azimuthal) pulsation components oscillate in phase at all stations, whereas the oscillations in the *H* (north–south) components have large phase shifts among the stations. The *H* component phase shift is often 180° between Durham ($L=3.2$) and Lac Rebours ($L=4.0$). A satellite measurement of the plasmapause location during one Pi 2 event showed that the large *H* component phase shift occurred near the plasmapause. Therefore the Pi 2 oscillations, which are originally excited at high latitudes in the magnetosphere, apparently couple to the shear Alfven waves of the resonant local field lines at the plasmapause because of the sharp decrease in the wave phase velocity just inside the plasmapause. This result suggests the possibility of determining the location of the night side plasmapause by monitoring the polarization changes of Pi 2 pulsations along a geomagnetic meridian. The Pi 2 data from the conjugate pair stations showed that the *H* components oscillate in phase, whereas the *D* components oscillate out of phase. Therefore it is concluded that the Pi 2 waves oberved near $L=4$ can be characterized as odd mode standing Alfvén waves. (auth)

23813 ANALYSIS OF STORM SUDDEN COMMENCEMENTS FOR THE YEARS 1868–1967. Mayaud, P.N. (Institut de Physique du Globe, Université Paris VI, Paris, France). J. Geophys. Res. 80: No. 1, 111-122 (1 Jan 1975).

A list of a series of 2462 ssc's was made by studying the 100–year magnetic records in two antipodal sub–auroral observatories and in one low–latitude observatory. Various statistical results are set forth. The negative correlation between ssc amplitude and rise time postulated by Dessler et al. (1960) seems to be true for the more rapid ssc's (1–4 min). Yearly numbers of ssc's are much better correlated with yearly averages of the sunspot numbers than with yearly averages of the magnetic activity, and the 27–day recurrence tendency is very small. There does not exist a semiannual variation of the occurrences. Also, there does not exist any daily variation of the occurrences, but at subauroral latitudes there exists an outstanding daily variation of the amplitudes. Furthermore, the small seasonal dependence at low latitudes in the daily variation reported by Maeda et al. (1964) is confirmed and the existence of a very large seasonal dependence at subauroral latitudes is pointed out. The previous interpretations of Obayashi and Jacobs (1957) and of Wilson and Sugiura (1961) are discussed in relation to some of these results. (auth)

23814 SUBSTORM AND INTERPLANETARY MAGNETIC FIELD EFFECTS ON THE GEOMAGNETIC TAIL LOBES. Caan, M.N. (Department of Planetary and Space Science, University of California, Los Angeles, California 90024); McPherron, R.L.; Russell, C.T. J. Geophys. Res. 80: No. 1, 191-194 (1 Jan 1975).

The average relationship of the tail lobe magnetic energy density to the north–south component of the interplanetary magnetic field (IMF) and substorm expansion phase is investigated by using a superposed epoch analysis method. An enhanced average lobe energy density is observed to be associated with a southward component of the IMF prior to substorm breakup. Coincident with the expansion onset, the lobe field rapidly recovers, and the north–south component of the IMF turns northward. The average magnitude of the substorm–associated lobe field variation is measured to be ~14%, a value sifficiently large to enable the lobes to serve as the source of the energy dissipated during substorms. (auth)

23815 THE EFFECTS OF BODY GEOMETRY ON THE STRUCTURE IN THE NEAR WAKE ZONE OF BODIES IN A FLOWING PLASMA. Oran, W.A.; Stone, N.H. (Space Sciences Laboratory, Marshall Space Flight Center, Huntsville, Alabama 35812); Samir, U. J. Geophys. Res. 80: No. 1, 207-210 (1 Jan 1975).

Transverse profiles of ion currents were measured in the near wake zone of bodies having various geometries in a streaming plasma. The profiles were obtained for an approximately constant range of plasma properties, namely, $T_e \sim 900$°K, S~7, and $R_0/\lambda_d \sim 12$, where T_e is the electron temperature, S is the 'Mach' number, and R_0/λ_d is the body radius to Debye length ratio. In addition, ϕ_b, the body potential relative to the plasma, was varied systematically in the range -3 – -4.1 V for each body. It was found that the structure behind bodies presenting a circular cross section to the plasma flow exhibits a single axial current peak, whereas for bodies presenting a square or rectangular cross section the downstream structure resembles a relatively broad mesa with two or more peaks on top. The body's dimension in the flow direction does not alter the gross features of the near wake structure but primarily determines the relative amplitude of the peak structure and the downstream distance at which it occurs for a given ϕ_b. (auth)

23816 ENERGETIC He^+ IONS FROM THE RADIATION BELT AT LOW ALTITUDES NEAR THE GEOMAGNETIC EQUATOR. Scholer, M.; Hovestadt, D.; Morfill, G. (Max–Planck–Institut für Physik und Astrophysik, Institut für extraterrestrische Physik, Garching, Germany). J. Geophys. Res. 80: No. 1, 80-85 (1 Jan 1975).

Energetic helium ions trapped in the radiation belt can get lost through charge exchange by collisions with neutral exospheric hydrogen. Since the cross section for conversion of singly ionized He to neutral He is much greater than the cross section for conversion of doubly ionized He to neutral He, the energetic He flux can be considered to originate from the He^+ population of the radiation belt. At low altitudes the energetic neutral helium atoms are again converted to ionized helium by collisions with the neutral oxygen atoms of the atmosphere. When a model for the flux distribution based in all available measurements of equatorially mirroring α particles is assumed, the expected flux of ionized He at low altitudes near the geomagnetic equator is computed according to an extension of the equilibrium model

by Moritz (1972). It is assumed for the model calculations that the total ionized He particle distribution consists of singly charged He ions. A comparison of the results of the model calculations with measurements made in two different time periods with a proton–α particle telescope on board the low–altitude satellite Esro 4 below the radiation belt yields values of 6 and 23% for the percentage of singly charged helium in the trapped ionized helium at energies between 2.5 and 8 MeV. Accuracy of the results from the model calculations is limited by uncertainties in the trapped α particle characteristics, in the charge exchange cross sections above 1.5 MeV, and in the exospheric neutral hydrogen density. The different values obtained for the two periods is an indication of the variability of the He^+ radiation belt content and/or of the exospheric neutral hydrogen density. (auth)

23817 SUBSTORM–ASSOCIATED RECONFIGURATION OF THE DUSK SIDE EQUATORIAL MAGNETOSPHERE: A POSSIBLE SOURCE MECHANISM FOR ISOLATED PLASMA REGIONS.
Barfield, J.N. (Environmental Data Service, NOAA, Boulder, Colorado 80302); Burch, J.L.; Williams, D.J. J. Geophys. Res. 80: No. 1, 47-55 (1 Jan 1975).

A rapid reconfiguration of the dusk side magnetosphere was observed near the magnetic equator by particle and field experiments aboard Explorer 45 at 1715 UT on June 17, 1972. Following the onset of an 800–γ negative bay in the auroral zone, Explorer 45, inbound at 1700 MLT and $L \sim 5$, observed a sharp dropout of outer zone electrons (35–560 keV). Simultaneously, the plasma density dropped from a level typical of the plasmasphere to one typical of the ion trough, and plasma sheet proton fluxes (3.5–138.5 keV) increased, producing 1 100–γ depression in B, in a shift to a taillike configuration. Outer zone electrons with pitch angles near 45° returned with delay times consistent with injection near midnight at the time of dropout and eastward drift to the dusk meridian. The equatorial electrons were not observed, since shell splitting apparently placed them on pseudotrapped orbits. Approximately 45 min after the reconfiguration, the satellite reentered the plasmasphere, and the electron fluxes returned to previous levels. The injected protons extended well into the plasmasphere. In the next orbit, approximately 6 hours later, a region of isolated plasma was detected near apogee at 1400 MLT. There is therefore circumstantial evidence that the type of magnetospheric reconfiguration observed here is responsible for the detachment of regions of cold plasma from the plasmasphere. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

23818 (AD-785407) DYNAMIC MOLECULAR DEFLECTION. Final Report. Hill, R. M.; Gallagher, T. F. (Stanford Research Inst., Menlo Park, Calif. (USA)). 19 Jul 1974. Contract F44620-71-C-0089. 45p. (SRI-MP-74-31). NTIS $3.25.

An experiment that tests a novel method for deflecting molecular beams using inhomogeneous resonance fields is described. If an electric field rotates at the same frequency as a molecule placed in it, the field and molecule remain aligned and the dipole moment-electric field interaction does not average to zero. If the field is spatially inhomogeneous then there is a net force on the molecule. This force can be used in making a molecular beam deflector. Resonance deflection of molecules in the J = 0 and 1 rotational states of a molecular beam of CSF was observed. The deflection is produced by passing a collimated molecular beam of CSF through the center of a Te(111) microwave cavity which is oscillating at the J = 0 1 transition frequency, 11.019 GHz. The theory of the effect as well as potential applications are also discussed. (GRA)

23819 (AD-787790) ADVANCED ION SOURCE. Final Report on Phase 2, 22 June 1973–24 January 1974. See also AD-772833. King, H. J. (Hughes Research Labs., Malibu, Calif. (USA)). Mar 1974. 31p. NTIS $3.75.

The report describes optical design and brightness measurements of Cs^+ and I^- ion sources. Design and operation are also discussed. (GRA)

23820 (COO-2326-8) DISTRIBUTION OF ENERGY IN BIMOLECULAR CHEMILUMINESCENT REACTIONS INVOLVING HYDROGEN ATOMS. Progress Report, May 1, 1974–April 30, 1975. Stwalley, W. C. (Iowa Univ., Iowa City (USA)). [nd]. Contract AT(11-1)-2326. 15p. Dep. NTIS $4.00.

The final stages of development of a crossed molecular beam apparatus for the study of bimolecular chemiluminescent reactions, involving hydrogen atoms were completed. A stable, high-intensity, high-energy source of H atoms is operating and its intensity is $\sim 10^{15}$ H atoms/cm^2-sec at 1 meter. Average kinetic energies up to 5.5 ± 1 eV have been obtained. Initial attempts at observation of chemiluminescence are now underway using an Li_2 cross beam. (auth)

23821 (JAERI-M-5775) CHARACTERISTICS OF THE PULSED ELECTRON BEAM FROM FEBETRON 706. Hotta, H.; Tanaka, R.; Sunaga, H.; Washino, M.; Sugiura, T. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 25p. (In Japanese). Dep. NTIS (US Sales Only).

The pulsed electron beam, generated from a Febetron 706, was examined by several methods. Photographs of the emission of the beam profile indicated that the beam is self-focusing at a certain pressure of the gaseous medium. The phenomenon was further studied by measuring the depth-dose distribution in an aluminum set placed on the beam axis. A stack of aluminum absorbers and blue cellophane sheets was used as the dosimeter. The characteristics of the blue cellophane dosimeter was examined in detail. Other dosimeters were also used supplementally. The total energy per pulse was measured by an aluminum calorimeter. The dose distribution of bremsstrahlung in the laboratory was also measured by a thermoluminescence dosimeter. (auth)

23822 (JUL-995-KP) SCATTERING OF ATOMIC AND ION BEAMS ON METAL SURFACES. Lutz, H. O. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Aug 1973. 66p. (In German). INIS.

This work contains a review of the problems of the scattering of atomic and ion beams on metal surfaces. It was principally conceived as appendix to the German Fusion Memorandum. For this reason, low particle energies (eV region) are the main topic; in the region of 1 keV there was a lack of experimental material. In conclusion, characteristic problems with energies considerably over 1 keV have thus also been given. (GE)

23823 INVESTIGATION OF A POLARIZED NEUTRAL ATOMIC BEAM. Risler, R.; Gruebler, W.; Koenig, V.; Schmelzbach, P. A. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik). Nucl. Instrum. Methods; 121: No. 3, 425-430(1 Nov 1974).

An atomic beam apparatus producing a polarized neutral atomic beam is described. The beam intensity, its diameter and the mean velocity of the atoms are measured. The results of the investigation of the dependence of various parameters are presented. The results are used to optimize all parameters involved. An optimum atomic beam intensity of 1.8×10^{16} atoms per second is measured within a beam diameter of 10 mm. (auth)

23824 IMPROVEMENT OF THE ACCURACY OF THE DETERMINATION OF THE TIME OF FLIGHT OF MOLECULAR BEAMS. Kolosov, A. V. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk; No. 13, 47-48(Oct 1974). (In Russian).

Methods for eliminating errors in the determination of the time of flight of molecular beams, caused by the nonsynchronization of the beginning of the time readout and the beginning of the beam transmission were examined. An expression for the actual time of flight of the beam was derived. (JSR)

23825 IMPROVED FORM OF THE OSCILLATING ELECTRON ELECTROSTATIC ION SOURCE FOR ION ETCHING. Ghander, A. M.; Fitch, R. K. (Aston Univ., Birmingham, Eng.). Vacuum; 24: No. 10, 483-487(Oct 1974).

The performance of the oscillating electron electrostatic ion source has been improved by incorporating a small chimney into the ion exit aperture to reduce the field distortion at the aperture. A focussing electrode placed near the aperture, and at a negative potential with respect to the cathode, has also been added. This increases the ion beam intensity and also increases the total ion beam current by extracting more low energy ions from the source. When the source is used for ion etching, the specimen can be placed at some distance from the source to reduce the heating of the specimen by radiation from the source. Using argon ions, etching rates of copper film of more than 10 μm^{-1} h have been observed with this improved source. It has also been found that the ion beam contains electrons which are suppressed with the focusing electrode at more than 100 V. Thus it was found that to satisfactorily etch a glass specimen it was necessary to operate with the focussing electrode at cathode potential to avoid the build up of charges on the glass. (auth)

23826 PREPARATION OF FIELD ELECTRON/FIELD-ION EMITTERS BY ION ETCHING. Walls, J. M. (Univ. of Birmingham, Eng.); Southworth, H. N.; Rushton, G. J. Vacuum; 24: No. 10, 475-479(Oct 1974).

A new technique is described for the fabrication and resharpening of field emitters. This technique employs an ion gun and uses methods analogous to those used to produce thin foils for the transmission electron microscope. In this way it has proved possible to produce reliably sharp emitters of both metal and semiconducting materials and the technique is particularly useful when dealing with those materials normally difficult to electropolish or chemically etch. Applications lie not only in field of electron emission and field-ion microscopy, but may also be relevant to the development of high current electron sources for use in electron microscopy. (auth)

23827 SADDLE FIELD ION SOURCE OF SPHERICAL CONFIGURATION FOR ETCHING AND THINNING APPLICATIONS. Franks, J. (Ion Tech Ltd., Teddington, Eng.); Ghander, A. M. Vacuum; 24: No. 10, 489-491(Oct 1974).

The construction is described of a saddle field ion source with its axis of symmetry coincident with the centre of the ion beam. The source consists of a spherical cathode enclosing an annular anode. Source current-source voltage and source current-ion beam current characteristics are given for argon, nitrogen, helium and hydrogen. A typical energy distribution curve is shown for argon at 6 kV at 2×10^{-4} torr, the beam energy is 0.85 cf the anode potential and the half width is about 250 V. The beam density is about 1 mA cm^{-2}, and the beam divergence 4°. Applications of cylindrical and spherical sources are described to ion beam machining, thinning and surface analysis. (auth)

23828 NUMERICAL SOLUTION OF NONSTATIONARY BEAMS OF CHARGED PARTICLES. Bleivas, I. M.; Il'in, V. P.; Sveshnikov, V. M. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 31-39 (1974). (In Russian).

Algorithms for solution of nonstationary problems of electronics, which lead to calculation of electromagnetic fields and numerical integrated equations of movement of charged particles, are considered. It is suggested that, at each moment of time, the distribution of the potential is described by the Poisson equation. The fields are calculated by differential methods. A modified "large particle" method is described for modeling the space charge. The compiling high-speed electronic computer system is described as a means for automation of the process of solving

the problems stated, and examples of solutions of the problems are given. (tr-auth)

23829 IONIZATION OF AN ATOMIC BEAM BY MEANS OF CHARGE EXCHANGE. Hammon, W. (Bonn Univ. (F. R. Germany). Mathematisch-Naturwissenschaftliche Fakultaet). 18 Apr 1973. 41p. (In German). INIS.

With abstract. Available from the library of the Bonn Univ.

The method of ionization of the nuclear-polarized atomic beam by means of charge exchange reactions was proposed in 1968 as a promising method to increase considerably the current strength of atomic beam sources. In this method an intense nuclear-polarized hydrogen atom beam enters the magnetic field of a superconducting solenoid. An intense proton beam of some keV energy is shot in from the side so that the protons in the magnetic field move on spiral trajectories with a small drift rate and a large speed of rotation. In the present work, the suitability of the method under limiting conditions has been investigated. The generation of nuclear polarization and the use of the superconducting solenoid were dropped. The investigation of various charge exchange reactions was carried out in the 2-kG field of a conventional solenoid. The evaluations of the density of the atomic beam in the ionization volume were carried out by means of electron collision ionization. Prediction and measurement of the yield of the charge exchange reactions $H^+ + D \rightarrow H + D^+$ and $D^+ + H \rightarrow D + H^+$ were in good agreement. The suitability of the above charge exchange reactions for the ionization of the atomic beam was confirmed. 0.27-μA deuterons and 0.17-μA protons from the atomic beam were pulse-selected. The extractable ion currents directly behind the charge exchange arrangement can be given for deuterons of about 0.4 μA and for protons of about 0.25 μA. The efficiency of the device is about 4×10^{-4}. The use of the superconducting solenoid together with the apparatus improvements should give yields of polarized particles of up to 100 μA. (GE)

23830 THEORETICAL AND EXPERIMENTAL ASPECTS OF SECONDARY ION MASS SPECTROMETRY. Werner, H. W. (Philips Gloeilampenfabrieken NV, Eindhoven, Netherlands). Vacuum; 24: No. 10, 493-504(Oct 1974).

Secondary ion mass spectrometry (SIMS) can be used to investigate the composition of solids. By means of ion bombardment (energy 3 to 15 keV) the sample is sputtered away. The sputtered particles which are ejected immediately as ions (secondary ions) are characteristic for the composition of the sample. Separated in a mass spectrometer they can be used in principle for a quantitative analysis. A short survey on the different models, proposed to explain the emission of secondary ions, is given. The experimental techniques, which have to be carefully chosen for each experiment, are discussed in more detail, viz. choice of the primary particle: state of charge, element, current-density; selection of the secondary particles: positively or negatively charged, atomic or cluster ions, post-ionization of sputtered neutrals, high or low mass resolution. The parameters which are important for solving practical problems, viz. element-dependent ionic yield, quantitative analysis, limit of detection, material composition, resolution in depth, are also considered. Some examples from practice of SIMS are used to illustrate the wide range of applicability of the method. (auth)

23831 OSCILLATORY CROSS SECTIONS IN LOW-ENERGY ION SCATTERING FROM SURFACES. Erickson, R.L.; Smith, D.P. (Central Research Laboratories, 3M Company, St. Paul, Minnesota 55133). Phys. Rev. Lett. 34: No. 6, 297-299 (10 Feb 1975).

Oscillations in the low-energy noble-gas ion-scattering cross sections versus primary ion energy have been observed for a number of solid surfaces. This behavior is ascribed to resonant electron exchange between electronic states of the surface atom and the primary ion. The oscillations are sensitive to the particular electronic energy levels and to the chemical environment of the surface atom. (auth)

23832 MULTIDIRECTIONAL DOPPLER PUMPING: A NEW METHOD TO PREPARE AN ATOMIC BEAM HAVING A LARGE FRACTION OF EXCITED ATOMS. Gerritsen, H.J.; Nienhuis, G. (Fysisch Laboratorium, Rijksuniversiteit Utrecht, Utrecht, The Netherlands). Appl. Phys. Lett. 26: No. 6, 347-349 (15 Mar 1975).

We discuss some problems associated with obtaining an atomic beam with a large fraction of excited-state atoms. We show, e.g., that for sodium atoms to be pumped up into the $3^2P_{1/2}$ state, they must experience a minimum of three optical frequencies near the D_1 line. In order to achieve this with only one optical frequency, the following method is proposed: A strong laser beam impinges three times on an atomic beam, each time under a different angle, in such a way that for one velocity class the Doppler shift generates the three frequencies needed. The effects of the polarization of the laser beams are discussed. (auth)

23833 DOUBLE SCATTERING OF RARE GAS IONS FROM POLYCRYSTALLINE GOLD AND COPPER. Sharma, S.P. (Bell Telephone Laboratories, Inc., Columbus, Ohio 43213); Buck, T.M. J. Vac. Sci. Technol. 12: No. 1, 468-474 (Jan 1975).

Energy spectra of Ne, Ar, and Kr backscattered from polycrystalline gold and copper have been measured at various scattering angles for primary energies (E_0) in the range 4-30 keV. In these experiments, the heavier noble gas ions exhibit wider double-scattering shoulders than do the lighter noble gas ions as expected from kinematic considerations in case of Au. However, in case of Cu, the kinematic calculations give wider double-scattering shoulders for Ne^+ than for Ar^+ for $\theta \geq 120°$. The shoulders depend upon θ, and the ratio of the scattering yield at the shoulder to scattering yield at the main peak (I_2/I_1) decreases with increasing scattering angle θ in all systems studied in this paper, as expected from scattering cross-section considerations. However, for a given primary ion the ratio (I_2/I_1) is lower for gold than for copper at a given E_0 and θ in these experiments, contrary to what might be expected from scattering cross-section considerations. (auth)

23834 SCATTERING OF LIGHT ATOMS FROM STRONGLY PERIODIC SURFACES. Stoll, A.G. Jr.; White, R.E.; Ehrhardt, J.J.; Masel, R.I.; Merrill, R.P. (Department of Chemical Engineering, University of California, Berkeley, California 94720). J. Vac. Sci. Technol. 12: No. 1, 192-198 (Jan 1975).

Atomic scattering from weakly periodic metal surfaces exhibits no diffraction, but the phenomenological effects of strong inelastic transitions are clearly evident, particularly for the larger, more polarizable rare gases. Strongly periodic surfaces like LiF display resolved He diffraction and rainbow scattering of Ne for thermal beams. The W(112) surface, perpendicular to its close-packed ridges, shows both diffraction of He and rainbow scattering of Ne. Semiclassical trajectory calculations reproduce these results for He scattering from metal surfaces, indicating the absence of any structured scattering along nearly close-packed rows. The calculations indicate that the effective scattering cross sections are larger than those based on crystal radii, and predict diffraction maxima at energies of $2kT_s$ and the observed relative intensities. Simple Debye-Waller analysis appears to describe thermal attenuation of diffraction maxima, and apparent mean square displacements are equal to those based on electron scattering. He diffraction is sensitive to the presence of ordered adsorbed layers, but quantitative interpretation of the surface structures is yet to be worked out. (auth)

23835 NONDIVERGENT RADIATION OF DISCRETE FREQUENCIES IN CONTINUOUS X-RAY SPECTRUM. Das Gupta, K. (Texas Tech. Univ., Lubbock). Phys. Rev. Lett.; 33: No. 24, 1415-1418(9 Dec 1974).

A strong nondivergent beam of radiation from targets with cylindrical bores, emitted in a direction parallel to the target face, was observed when electrons strike the target at grazing angles. The spectroscopic analysis has so far revealed six discrete bands in the range 350 to 20 keV, which agree well with predicted values. The theory of bremsstrahlung apparently does not account for the high intensity in the forward direction or for the discrete frequencies of the radiation. (auth)

Atomic and Molecular Properties

Refer also to abstracts 23878, 23879, 23895, 23898, 23908, 23910, 23911, 23913, 23930, 24283, 24290, 24329, and 24479.

23836 (AD-784579) WIDTHS OF ATOMIC M-SHELL VACANCY STATES AND QUASIATOMIC ASPECTS OF RADIATIONLESS TRANSITIONS IN SOLIDS. Chen, M. H.; Ringers, D. A.; Ceasemann, B.; Yin, L. I.; Tsang, T. (Oregon Univ., Eugene (USA). Dept. of Physics). 25 Oct 1973. 13p. (AROD-10121.15-P). NTIS.

Widths of M-level vacancy states in atoms with Z = 29 to 48 were measured by x-ray photoelectron spectroscopy. The results are consistently smaller, sometimes by a factor of 3, than expected from previous theory, and do not show the pronounced effect of predicted "super-Coster-Kronig" transitions. The Cu and Zn auger and M photoelectron spectra were measured; the auger spectra exhibit characteristics of free-atom spectra and do not reflect the structure of the band from which the M electrons originate. Drawing upon this and other evidence suggesting that atoms in solids can behave as quasifree when undergoing radiationless transitions, free-atom M auger and Coster-Kronig energies were computed. These are smaller than measured energies because the effect of extra-atomic relaxation is absent. M-level widths were calculated with these energies, in a neutral-atom potential. Good agreement with experiment is attained. (auth)

23837 (CONF-730660-P1, pp A17-A31) PROJECTIVE GEOMETRY AND DYNAMICAL GROUPS. Bacry, H. (Univ., Marseille). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

Simple geometrical arguments lead to a description of the relation between some symplectic manifolds of motions and ray spaces. An application follows concerning the quantization of the 3-dimensional harmonic oscillator and the hydrogen atom. (auth)

23838 PHOTOIONIZATION CROSS SECTIONS FOR H_2 IN THE RANDOM PHASE APPROXIMATION WITH A SQUARE-INTEGRABLE BASIS. Martin, P. H. S.; Rescigno, T. N.; McKoy, V. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics); Henneker, W. H. (Paris-11 Univ., 91 – Orsay (France)). Chem. Phys. Lett.; 29: No. 4, 496-501(15 Dec 1974).

Total photoionization cross sections for H_2 are calculated in the random phase approximation (RPA) through a numerical analytic continuation procedure applied to the polarizability for complex values of the frequency. The representation of the polarizability that is required is obtained from a discrete set of excitation energies and oscillator strengths that satisfies the Thomas–Reiche–Kuhn sum rule exactly and other energy-weighted sum rules approximately. The fact that the excitation spectrum is obtained through a solution of the RPA equations with no continuum functions added to the basis makes the method well suited for general molecular photoionization calculations. The results are compared with experiment and good agreement is found. (auth)

23839 FINE STRUCTURE IN RYDBERG STATES OF THE H_2 MOLECULE. Jette, A. N. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.); Miller, T. A. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)). Chem. Phys. Lett.; 29: No. 4, 547-550(15 Dec 1974).

The electron spin–nuclear rotation interaction is considered for the np $^3\Pi_u$ Rydberg series of the H_2 molecule for which many experimental data are available. Earlier formulations of this interaction are reconciled, and consistent formulae for both the heteronuclear and homonuclear case are presented. Theoretical calculations of various contributions are given and compared to experimental results. Excellent agreement between calculated and experimental values is obtained for the np Rydberg series of H_2 including H_2^+. (auth)

23840 RECENT PROGRESS ON THE INTERPRETATION OF THE $4f^N(5d + 6s)$ CONFIGURATIONS IN THE LANTHANIDES. II. Wyart, J. F.; Blaise, J.; Camus, P. (Centre National de la Recherche Scientifique, Orsay, France). Phys. Scr.; 9: No. 6, 325-330(Jun 1974).

An extensive study of the configurations $4f^N(5d + 6s)$, using the methods of Racah, which included the configuration interaction for these two configurations and effective parameters for the 4f-5d interaction leads to an improved agreement between observed and calculated energies for seven spectra and to new energy levels for Pr III, Pr II and Tm II. Because of the regularities of the radial parameters either in the isoelectronic series or in the same stage ionization sequences, it is possible to predict the energy difference of many levels for Er III and HfV. (auth)

23841 PHENOMENA ASSOCIATED WITH NEAR-THRESHOLD EXCITATION OF AUTOIONIZING LEVELS OF HELIUM BY ELECTRON IMPACT. Smith, A. J.; Hicks, P. J.; Read, F. H.; Cvejanovic, S.; King, G. C. M.; Comer, J.; Sharp, J. M. (Univ. of Manchester, Eng.). J. Phys., B (London); 7: No. 17, L496-L502 (1 Dec 1974).

A post-collision interaction model was proposed to explain the observed shifting of the energies of electrons ejected from autoionizing states of helium excited by low energy charged particles. The shifts are caused by an exchange of energy between the ejected electrons and the slow-moving scattered ions or electrons. It is shown that the model can be extended to include cases where very low energy scattered electrons are recaptured to form singly excited bound states of helium, the ejected electrons gaining the energy lost by the scattered electrons. Electron excitation functions of three bound states of helium are presented over the range 57 to 60 eV, and each shows structure which can be attributed to excitation of the $(2s^2)^1S$ autoionizing state at energies just above threshold. The empirical relation between the energy charge $f(E_1)$ of electrons ejected from $He(2s^2)^1S$ and the free energy E_1 of the scattered electrons was found to be $f(E_1) \propto E_1^{-1.2}$, and not $E_1^{-0.5}$ as predicted by the post-collision interaction model. In addition, several features in the yield of photons from helium over the incident energy range from 56 to 61 eV are interpreted in the light of the above findings. (auth)

23842 EXCITED STATE CHEMISTRY OF THE LOW PRESSURE HELIUM AFTER GLOW. I. Reactions Involving Metastable Species, 2^3S, and $2s^3\Sigma_u^+$. Pitchford, L. C.; Taylor, K. N.; Collins, C. B. (Univ. of Texas, Dallas). J. Phys., B (London); 8: No. 1, 142-155(11 Jan 1975).

The quantitative modelling of the chemistry of the $He(2^3S)$ and $He_2(2^3\Sigma_u^+)$ metastables in a pulsed helium afterglow at 1.86 Torr is reported. A comprehensive nine-term model is used to fit spectroscopic measurements of the time-dependent evolution of metastable concentrations. The same coefficients are found adequate to predict the time-dependence of the electron density as measured with a microwave Fabry-Perot interferometer. Rate coefficients obtained agree with previous values where such prior measurements were made and in other cases the first measurements for those reactions are reported. In particular, a rate coefficient of $(3.85 \pm 0.5) \times 10^{-9}$ cm^3 s^{-1} was found for the reaction $He_2(2^3\Sigma_u^+) + He_2(2^3\Sigma_u^+)$; a value of $(1.7 \pm 0.4) \times 10^{-9}$ cm^3 s^{-1} for $He_2(2^3\Sigma_u^+) + e$; and an upper limit of 0.8×10^{-9} cm^3 s^{-1} for $He(2^3S) + He_2(2^3\Sigma_u^+)$. (auth)

23843 APPLICATION OF AN APPROXIMATE FORMULA FOR THE GROUND-STATE ENERGY TO STARK EFFECT. Tint, M.; Myint, H. (Arts and Science Univ., Mandalay, Burma). Phys. Lett., 49A: No. 6, 471-472(21 Oct 1974).

The accuracy of an approximate formula derived by Chi-Yu Hu and others is discussed. This formula is then applied to Stark effect in atomic hydrogen. (auth)

23844 UNUSUAL ELECTRONIC PRECORRELATION AND CORRELATION EFFECTS IN THE $^{1,3}\Pi_L$ STATES OF THE HYDROGEN MOLECULE. Tal, Y.; Katriel, J. (Technion-Israel Inst. of Tech., Haifa). J. Phys., B (London); 7: No. 16, 2113-2120(11 Nov 1974).

The variation of two-electron properties such as $\langle 1/r_{12} \rangle$, $\langle r_{12} \rangle$ upon variation of the internuclear distance was investigated for some excited states of the hydrogen molecule. A nonmonotonic behavior of these quantities in the $^3\Pi_u$ state is contrasted with the monotonic behavior in the $^1\Pi_u$ as well as in the $^3\Sigma_g$. The larger correlation energy in the $^3\Pi_u$ than in the $^1\Pi_u$ is related to the differences in the Pauli precorrelation between them. (auth)

23845 RADIAL INTEGRALS AND ENERGY LEVEL FINE STRUCTURE OF COMPRESSED HYDROGEN ATOM. Savukinas, A. Yu.; Chizhyunas, A. R. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 3, 477-489(1974). (In Russian).

Radial integrals $\langle r^t \rangle$ and fine structure of the energy levels are considered for the compressed hydrogen atom. Boundary conditions $R(r_0) = 0$, $R'(r_0) = 0$, and $P'(r_0) = 0$ for radial orbitals are used with finite r_0. The radial integrals and energy values are obtained for a number of the hydrogen atom states by numerical solution of the Schrödinger equation with these boundary conditions. The dependence of the radial integrals $\langle r^t \rangle$ and the fine structure of energy levels on the limiting radius r_0 is investigated. (4 figures, 5 tables) (auth)

23846 PRECISE ATOMIC MASS DIFFERENCES FOR 68 LESS THAN OR EQUAL TO Z LESS THAN OR EQUAL TO 72. Barber, R. C. (Univ. of Manitoba, Winnipeg); Barnard, J. W.; Burrell, D. A.; Meredith, J. O.; Southon, F. C. G.; Duckworth, H. E. Can. J. Phys.; 52: No. 23, 2386-2394(1 Dec 1974).

A high resolution mass spectrometer has been used to determine new values for 16 atomic mass differences involving naturally occurring isotopes for $68 \leq Z \leq 72$. These new determinations, which were derived by means of a computer assisted peak matching system, have a precision ranging from 0.6 to 2.0 μu (0.6 to 1.8 keV) and thus are generally more precise than the corresponding nuclear reaction or decay Q values available in the region. (auth)

23847 PHOTODISSOCIATION OF H_2^+: VARIATION WITH TEMPERATURE. Argyros, J. D. (University Coll., London). J. Phys., B (London); 7: No. 15, 2025-2035(21 Oct 1974).

Theoretical results are presented for the photodissociation cross section of H_2^+ from the $1s\sigma_g$ ground electronic state to the vibrational continuum of the $2p\sigma_u$ state. Values of the cross section were calculated for rotational states $0 \leq J \leq 8$. A total cross section was evaluated for temperatures $2500 < T(K) < 26{,}000$, in the wavelength region $500 \leq \lambda(A) \leq 25{,}000$, assuming a Boltzmann distribution. The variation of the cross section with temperature is discussed. It is concluded that for $T \geq 10{,}000$ K, the total cross section would be improved by including more

rotational states. An empirical extrapolation procedure is proposed using the available results to obtain cross sections accurate at high temperatures. (auth)

23848 FINITE-DIFFERENCE NEWTON–RAPHSON SOLUTION OF THE TWO-CENTER ELECTRONIC SCHROEDINGER EQUATION. Cayford, J. K.; Fimple, W. R.; Unger, D. G.; White, S. P. (Canterbury Univ., Christchurch, New Zealand). J. Comput. Phys.; 16: No. 3, 259-270(Nov 1974).

An alternative approach to the solution of the two-center electronic Schrödinger equation involving a finite-difference Newton–Raphson algorithm is described. The usual separation in confocal elliptical coordinates is employed leading to two coupled one-dimensional differential equations with split boundary conditions. The corresponding set of finite-difference equations, including the energy eigenvalue, separation constant, boundary conditions, and normalization conditions, are incorporated into a large system of nonlinear algebraic equations which is solved by means of a generalized Newton–Raphson iteration. The present algorithm is relatively simple and flexible. Solutions at one value of the nuclear separation can be easily tracked into solutions at other values. Also with a modification of the boundary conditions continuum states can be obtained as easily as bound states. As examples, calculations of the $2s\sigma_g$ bound state and a positive-energy continuum state of H_2^+ at a separation R = 5.0 AU are presented. Through the use of a generalized Richardson extrapolation, an accuracy of eight significant figures was achieved. (auth)

23849 PERTURBATION THEORY FOR SHORT–RANGE ATOMIC INTERACTIONS. I. NUMERICAL RESULTS. Certain, P.R.; Merkel, R.R. (Department of Chemistry and Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 62: No. 4, 1402-1408 (15 Feb 1975).

Numerical results for various perturbation series for atomic interactions at short range are presented for the energy, dipole moment, and dipole polarizability of one–electron diatomics. Although third–order energy results are accurate at short range, there is appreciable error in the other property values. The convergence of the series is considered in a companion paper. (auth)

23850 VIBRATION–ROTATION RELAXATION IN He–H_2. Rabitz, H.; Zarur, G. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 62: No. 4, 1425-1434 (15 Feb 1975).

Vibration–rotation relaxation calculations for He^4–(para–H_2) are presented over the range $200 \leq T \leq 700$°K. The relaxation equations are solved for up to 12 vibration–rotation states. The rate constants were obtained from previously calculated quantum mechanical collision cross sections. It is shown that the eigenvalues and eigenvectors of the relaxation matrix may be physically interpreted in terms of different relaxation modes. Details of the relaxation are followed as a function of time. A rich variety of rotational relaxation behavior is shown to be possible at short times followed by a quiescent induction period and finally vibrational relaxation. Breathing sphere calculations were also performed, and they were found to be inadequate for describing the vibrational relaxation. The rotational states significantly participate in the vibrational relaxation of He–H_2. (auth)

23851 HIGHER–ORDER RELATIVISTIC CONTRIBUTIONS TO THE ZEEMAN EFFECT IN HELIUM AND HELIUMLIKE IONS. Lewis, M.L.; Hughes, V.W. (Gibbs Laboratory, Physics Department, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 11: No. 1, 383-384 (Jan 1975).

The higher–order relativistic contributions to the Zeeman effect in triplet states in helium and heliumlike ions have been calculated to order $\alpha^3\mu_B H$. (auth)

23852 EXACT ELECTROMAGNETIC MATRIX ELEMENTS AND SELECTION RULES FOR RELATIVISTIC HYDROGENIC ATOMS. Moses, H.E. (Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Massachusetts 01730). Phys. Rev. A 11: No. 1, 387-389 (Jan 1975).

We give the exact matrix elements (i.e., with retardation taken into account exactly) for the electromagnetic interaction for relativistic hydrogenic atoms in terms of integrals of the atomic radial functions. The present paper represents an extension of earlier results for the nonrelativistic case. The matrix elements can be used to obtain the exact selection rules and transition probabilities per unit time for the emission of a photon. (auth)

23853 COMPARISON OF DOUBLY–EXCITED HELIUM ENERGY LEVELS, ISOELECTRONIC SERIES, AUTOIONIZATION LIFETIMES, AND GROUP–THEORETICAL CONFIGURATION–MIXING PREDICTIONS WITH LARGE–CONFIGURATION–INTERACTION CALCULATIONS AND EXPERIMENTAL SPECTRA. Herrick, D.R.; Sinanoğlu, O. (Sterling Chemistry Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 11: No. 1, 97-110 (Jan 1975).

For comparison with our recent group–theoretical predictions of configuration–mixing coefficients, we report extensive configuration–interaction calculations for doubly excited states in the helium isoelectronic sequence below the $N = 2$ (S, P, D states), $N = 3$ (S,P,D,F,G states), $N = 4$ (S,P,D states), and $N = 5$ ($^1P^o$ states) ionization thresholds. Two new quantum numbers label the Rydberg series, and are used to predict three "selection rules" for dipole excitation and autoionization processes which agree with experiment. New autoionization widths are reported for the helium states and confirm our group–theoretically predicted selection rules. Our width of 0.151 eV for the $^1P^o$ state at 62.92 eV is in agreement with the recent experimental value 0.132 ± 0.014 eV. Calculations of helium energies and autoionization widths are strongly affected by "avoided crossings" of the doubly excited states as Z is varied continuously. The new quantum numbers project out states in H^- which correspond to observed $^1P^o$ shape resonances above the $N = 2$ and 3 ionization thresholds. (auth)

23854 CALCULATION OF AUTOIONIZATION PROBABILITIES FOR HELIUM AND HELIUMLIKE IONS. Zemtsov, Yu. K. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 356-358 (Oct 1974).

Autoionization probabilities for two-electron systems (He and He-like ions) were calculated for values of the principal quantum number $n \leq 10$ and nuclear charge $Z \leq 10$. The calculations were performed by two methods: extrapolating the cross sections for ionic excitation to the threshold region and direct calculation of two-configuration matrix elements. For large values of n, both methods give similar results. (auth)

23855 SPECTRUM OF DOUBLY IONIZED YTTRIUM (Y III). Epstein, G.L. (NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771); Reader, J. J. Opt. Soc. Am. 65: No. 3, 310-314 (Mar 1975).

The spectrum of doubly ionized yttrium was observed from 600 to 9700 Å by means of plane– and concave–grating spectrographs at NBS. About 100 new lines were observed. From these measurements, 40 new energy levels were derived. The known level system (Rb I isoelectronic sequence, $4p^6nl$) now includes the series ns (n = 5–9), np (n = 5–9), nd (n = 4–8), nf (n = 4–10), ng (n = 5–8), and nh (n = 6–8). The *nf* series shows irregular fine–structure splittings, 4*f* having a negative splitting of about 3 cm^{-1}. The ionization energy of Y III was determined to be 165540.5 ± 1.0 cm^{-1} (20.52457 ± 0.00012 eV). A re–examination of Kiess's data for Zr IV in the light of the Y III analysis yielded a revised value for the ionization energy of Zr IV of 277550 ± 20 cm^{-1} (34.412 ± 0.003 eV). (auth)

23856 LYMAN–BAND FLUORESCENCE INTENSITY VS H_2 PRESSURE. Inn, E.C.Y.; Starr, W.L. (Ames Research Center, NASA, Moffett Field, California 94035). J. Opt. Soc. Am. 65: No. 3, 320-322 (Mar 1975).

The fluorescence intensity of the H_2 Lyman bands ($B\ ^1\Sigma_u^+ \rightarrow X\ ^1\Sigma_g^+$) excited by the argon 1066 Å line was found to have a linear dependence on H_2 pressure at pressures less than 10^{-3} torr. The fluorescence from the HD that occurs naturally in the hydrogen was found to be similarly dependent on the HD partial pressure. (auth)

23857 DOPPLER–FREE TWO–PHOTON SPECTROSCOPY OF HYDROGEN 1*S*–2*S*. Hänsch, T.W.; Lee, S.A.; Wallenstein, R.; Wieman, C. (Department of Physics, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 34: No. 6, 307-309 (10 Feb 1975).

We have observed the 1*S*–2*S* transition in atomic hydrogen and deuterium by Doppler–free two–photon spectroscopy, using a frequency–doubled pulsed dye laser at 2430 Å. Simultaneous recording of the absorption spectrum of the Balmer–β line at 4860 Å, using the fundamental dye–laser output, allowed us to compare precisely the energy intervals 1*S*–2*S* and 2*S*, *P*–4*S,P,D* and to determine the Lamb shift of the 1*S* ground state to be 8.3±0.3 GHz (D) and 8.6±0.8 GHz (H). (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 24313.

23858 NUCLEAR EXCITATION AND ISOMER SHIFTS IN MUONIC ATOMS. I. Experiment and Evaluation. Backe, H.; Engfer, R.; Kankeleit, E.; Link, R.; Michaelsen, R.; Petitjean, C.; Schellenberg, L.; Schneuwly, H.; Schroeder, W. U.; Vuilleumier, J. L. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., A; 234: No. 2, 469-503 (2 Dec 1974).

Energies and intensities of 53 nuclear γ-lines in muonic atoms of Sm, Gd, Eu, Tm, Yb, Ta, W, Re, Os, Ir, Pt, Hg, Tl, and Bi measured with Ge(Li) detectors. By comparison with γ-lines from radioactive sources the isomer shifts for transitions from nuclear rotational levels, quadrupole and octupole vibrational levels, and single-particle levels were deduced. The effect limiting the accuracy of the extracted isomer shifts is the correction for the magnetic hyperfine splitting of the nuclear levels. (auth)

23859 EMPIRICAL FORMULA FOR ENERGY LEVEL SHIFTS OF PIONIC ATOMS. Cheon, I.-T. (Liege Univ. (Belgium)); von Egidy, T. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Nucl. Phys., A; 234: No. 2, 401-412 (2 Dec 1974).

An empirical formula for energy level shifts of pionic atoms is proposed. Numerical results show remarkably good agreement with experimental data. Energy level shifts and widths are predicted for pionic deuterium, tritium and helium. With these values, scattering lengths of π-d, π-t and π-^{3}He are also calculated. The results are (in fm) −0.083 + 0.024 i, −0.287 + 0.028 i and 0.067 + 0.035 i, respectively. (auth)

23860 NUCLEAR EXCITATION AND ISOMER SHIFTS IN MUONIC ATOMS. II. Model-Independent Parametrization and Discussion. Walter, H. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., A; 234: No. 2, 504-532(2 Dec 1974).

Excitation probabilities and isomer shifts for about 50 excited nuclear levels from muonic atoms of Sm, Gd, Eu, Tm, Yb, Ta, W, Re, Os, Ir, Pt, Hg, Tl, and Bi are discussed. The data for ^{153}Eu are used in comparison with isomer shifts from the Moessbauer technique to evaluate electron density differences in rare earth compounds. Moessbauer and muonic isomer shifts are sensitive to different moments of the change of the charge distribution. Therefore, from a comparison new information can be deduced. The results of the muonic isomer shifts are compared with calculations based on various nuclear models. (auth)

23861 INFLUENCE OF SPUR PROCESSES ON POSITRONIUM FORMATION IN SOME MIXTURES OF ORGANIC LIQUIDS. Jansen, P.; Eldrup, M.; Mogensen, O. E.; Pagsberg, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Chem. Phys. (Amsterdam); 6: No. 2, 265-271(Nov 1974).

To test some predictions of the spur reaction model of positronium (Ps) formation, positron lifetime studies of the following binary organic mixtures: (a) dioxane/n-heptane, (b) triethylamine/n-heptane, (c) pyrrolidine/n-heptane, and (d) carbon disulphide/n-hexane were performed. The results were in agreement with the model, which explains the influence on Ps formation by proton spur reactions (cases a, b, and c), solvation of spur electrons and positron (cases b and c), and electron trapping on carbon disulphide combined with high electron mobility in pure carbon disulphide (case d). The ortho-Ps lifetimes were compared with the predictions of two theoretical models, none of which could reproduce the lifetimes in detail. (auth)

23862 IMPROVED VERTEX CONTRIBUTION TO THE DECAY RATE OF ORTHOPOSITRONIUM. Stroscio, M. A. (Air Force Cambridge Research Labs., Bedford, Mass. (USA)). Phys. Lett., A; 50: No. 2, 81-82(18 Nov 1974).

The recently calculated decay rate of orthopositronium differs with the experimental value by 2½ standard deviations. This letter reports a 50-fold improvement in the numerical error estimate for the vertex diagram contribution to the decay rate. (auth)

23863 MUONIC U_3-CENTERS. Meier, P. F.; Schenck, A. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Phys. Lett., A; 50: No. 2, 107-108(18 Nov 1974).

Positive muons implanted in nonconducting solids form with high probability hydrogenlike muonium atoms (μ^+e^-) with properties similar to those of U_3-centers. The influence of a superhyperfine interaction with neighbor nuclei on the evolution of the muon's polarization are studied. (auth)

23864 MAGNETIC HYPERFINE INTERACTION IN MUONIC INDIUM, OSMIUM AND MERCURY. Link, R. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 269: No. 2, 163-171(1974).

Part of a thesis.

The magnetic hyperfine interaction in several muonic atoms has been measured. The magnetic splittings of the $1s_{\frac{1}{2}}$, $2s_{\frac{1}{2}}$ and $2p_{\frac{1}{2}}$ muon states in the $^9/_2^+$ ground state of ^{115}In, determined by measuring muonic x rays, are ΔE_{mag} ($1s_{\frac{1}{2}}$, ^{115}In $^9/_2^+$) = 3,580 ± 70 eV; ΔE_{mag} ($2s_{\frac{1}{2}}$, ^{115}In $^9/_2^+$) = 525 ± 120 eV; ΔE_{mag} ($2p_{\frac{1}{2}}$, ^{115}In $^9/_2^+$) = 850 ± 180 eV. The magnetic splitting of nuclear γ rays in the presence of a muon in the $1s_{\frac{1}{2}}$ state yields for the $^1/_2^-$ ground state in ^{199}Hg ΔE_{mag} ($1s_{\frac{1}{2}}$, ^{199}Hg $^1/_2^-$) = 468 ± 115 eV and the following values for the first excited 2^+ states in the nuclei ^{190,192}Os and 200 Hg: ΔE_{mag} ($1s_{\frac{1}{2}}$, ^{190}Os 2^+) = 665 (+80, −40) eV; ΔE_{mag} ($1s_{\frac{1}{2}}$, ^{192}Os 2^+) = 800 ± 80 eV; ΔE_{mag} ($1s_{\frac{1}{2}}$, ^{200}Hg 2^+) = 655 (+105, −75) eV. These data are compared with calculations using different nuclear models. (auth)

23865 NEW MEASUREMENT OF THE POSITRONIUM HYPERFINE INTERVAL. Mills, A.P. Jr.; Bearman, G.H. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. Lett. 34: No. 5, 246-250 (3 Feb 1975).

The hyperfine interval $\Delta\nu$ of the positronium ground state has been measured with significantly improved accuracy. Using a SF_6 buffer gas we obtain $\Delta\nu$=203.3875±0.0017 GHz and $(\Delta\nu)^{-1}\,\partial\Delta\nu/\partial D$ = (−8.0±0.4) ×10^{-5} amagat^{-1}. Using a N_2 buffer gas we obtain $\Delta\nu$=203.3854±0.0029 GHz and $(\Delta\nu)^{-1}\,\partial\Delta\nu/\partial D = (-2.1 \pm 0.6) \times 10^{-5}$ amagat^{-1}. No evidence is found for a quadratic dependence of $\Delta\nu$ on density in either gas. (auth)

23866 CRITICAL DISCUSSION OF THE VACUUM POLARIZATION MEASUREMENTS IN MUONIC ATOMS. Rafelski, J.; Müller, B.; Soff, G.; Greiner, W. (Institut für Theoretsche Physik der Universität, Frankfurt am Main, Germany). Ann. Phys. (N.Y.) 88: No. 2, 419-453 (Dec 1974).

Recent disagreement between theoretical and experimental values of transition energies for outer states in muonic atoms is discussed in the range of 150−440 keV. A brief review of the present status of calculation of the theoretical contributions is given. A rigorous theoretical framework for the electron−muon system is considered. A set of self−consistent equations is derived. Several mechanisms for the explanation of the discrepancy are discussed. No explanation within the frame of standard quantum electrodynamics is found. (auth)

23867 OBSERVATIONS OF POSITRONIUM LYMAN−α RADIATION. Canter, K.F.; Mills, A.P. Jr.; Berko, S. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. Lett. 34: No. 4, 177-180 (27 Jan 1975).

The first observation of Lyman−α radiation from positronium is described. Positronium is formed in vacuum by a slow positron beam incident on a solid target. Single photons transmitted through an ≃20−Å−wide interference filter peaked near the 2430−Å Lyman−α ($2P\rightarrow1S$) line of positronium are observed in coincidence with the annihilation γ's of ground-state positronium. The observed intensity corresponds to a production of one positronium "atom" in the excited state for every 10^4 incident positrons. (auth)

23868 COMMENT ON THE VALIDITY OF THE SLATER APPROXIMATION IN ELECTRON SCREENING IN EXOTIC ATOMS. Mann, J.B.; Rinker, G.A. Jr. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. A 11: No. 1, 385-386 (Jan 1975).

We have calculated electron screening corrections in muonic Ba and Pb using true relativistic Hartree−Fock electron densities. We find that the error due to the usual local Slater approximation to the exchange potential is small, on the order of 1−2% of the total screening correction in those cases where the screening is significant. (auth)

23869 MASS DEPENDENCE IN MESONIC ATOMS. Condo, G.T. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. A 11: No. 1, 376-377 (Jan 1975).

Comparison of muonic− and kaonic−atom x−ray data with recent calculations on the formation and deexcitation of mesonic atoms indicates that, relative to muons, kaons preferentially populate states of lower orbital angular momentum when initially forming a mesonic atom. (auth)

23870 MUONIUM−FORMATION MEASUREMENT IN LOW−PRESSURE ARGON GAS. Barnett, B.A.; Chang, C.Y.; Yodh, G.B. (University of Maryland, College Park, Maryland 20742); Carroll, J.B.; Eckhause, M.; Hsieh, C.S.; Kane, J.R.; Spence, C.B. Phys. Rev. A 11: No. 1, 39-41 (Jan 1975).

Direct precession measurements of the muonium atomic system have been made in argon gas at low pressures of 1290 and 2280 Torr. At the higher pressure the probability of muonium formation was found to be (85 ± 9) %. This lower limit for the rate of formation is in agreement with that predicted by Firsov and Byakov on the basis of muonium energy thresholds. (auth)

23871 OBSERVATION OF THE *E*2 NUCLEAR RESONANCE EFFECT IN PIONIC CADMIUM. Bradbury, J.N.; Leon, M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544); Daniel, H.; Reidy, J.J. Phys. Rev. Lett. 34: No. 6, 303-306 (10 Feb 1975).

Nuclear resonance effects in mesonic atoms result from near degeneracy of nuclear excitation and atomic de−excitation energies. The

$E2$ nuclear resonance effect was observed in pionic cadmium by comparing selected pionic x-ray intensity ratios from ^{112}Cd with those from ^{111}Cd. The effect for hadronic atoms is now unambiguously established and the results are in close agreement with the theoretical predictions. (auth)

23872 ESTIMATE OF THE $(Z\alpha)^2\alpha^2$ VACUUM POLARIZATION TERM IN MUONIC Pb. Wilets, L. (Physics Department, University of Washington, Seattle, Washington 98195); Rinker, G.A. Jr. Phys. Rev. Lett. 34: No. 6, 339-341 (10 Feb 1975).

We have calculated the static monopole contributions to the $(Z\alpha)^2\alpha^2$ vacuum polarization correction for the $4f_{5/2}$ state in muonic Pb. We find an energy shift of -1 ± 0.1 eV (increased binding). We argue that neglected higher multipole contributions have the same sign and similarly small magnitude, thus increasing by a slight amount the current discrepancy between muonic atom theory and experiment. (auth)

23873 RADIATIVE CORRECTIONS OF ORDER α^2 IN MUONIC ATOMS OF HEAVY NUCLEI. Chen, M. (Physics Department, Columbia University, New York, New York 10027). Phys. Rev. Lett. 34: No. 6, 341-344 (10 Feb 1975).

A part of the hitherto neglected radiative corrections of order α^2 is calculated. Its inclusion in the analysis virtually eliminates all the discrepancies between the measured and the calculated energies of the $5g-4f$ transitions in muonic atoms of heavy nuclei. (auth)

Collision Phenomena

Refer also to abstracts 23829, 23841, 23842, 23937, and 24435.

23874 (AD-785945) ATOMIC INTERACTIONS BASIC TO MACROSCOPIC PROPERTIES OF BASES. Final Report, 1 September 1970–28 February 1973. Scott, J. E. Jr. (Virginia Univ., Charlottesville (USA). Dept. of Engineering Science and Systems). Jul 1974. Contract F33615-69-C-1048. 109p. (ESS-3440-101-74; ARL-74-0103). NTIS $5.25.

A final report of effort on a comprehensive research program on atomic and molecular collision processes, in which the microscopic aspects of various collision events are studied both from the theoretical and experimental points of view, is described. Particular emphasis is placed on the manner in which these processes determine the macroscopic properties of gases; e.g., the transport properties of gases at high temperature, and the manner in which energetic radiation interacts with matter. A report on the progress on each of the six research tasks comprising a unified program based on experimental methods using atomic, ionic, and molecular beam methods and on the use of many-body perturbation theory and atomic interaction potentials for the calculation of atomic and molecular properties, scattering cross sections and transport properties of high temperature gases, is presented. (auth)

23875 (AD-786761) TECHNICAL REPORTS, 1 MAY–30 SEPTEMBER 1974. Sellin, I. A. (Tennessee Univ., Knoxville (USA)). 20 Sep 1974. 99p. NTIS $4.75.

The technical report concerns work performed to date on the projects entitled "Structure of highly stripped nitrogen, oxygen, fluorine, chlorine, and argon ions" and "Structure of highly ionized heavy ions and associated collision phenomena in the MeV/nuclear range." Specifically, accumulated preprints and reprints of articles plus abstracts of work to be published are included, together with a catalog of these items. Reports include: lifetimes of the metastable autoionizing states of lithiumlike Al(10^+) and Si(11^+) ions; comparisons with theory over the isoelectronic sequence Z = 8-18; symmetric ion atom collisions at medium energies I: characteristic x-rays; characterization of charge states of energetic ions in solids from associated k x-ray production; autoionizing lifetimes of the metastable state in the lithiumlike ions Al(10^+), Si(11^+), and S(13^+); xuv spectra of highly ionized fluorine and oxygen; new lines in the xuv spectrum of heliumlike fluorine; radiative transitions in two-electron oxygen; neon k alpha, k beta satellite structure induced by 80-MeV argon-ion impact; observations of k x-rays from highly ionized states of neon produced by 40 MeV Cl(+7), Cl(+11), and Cl(+13) beams; charge state dependence of Si k x-ray production in solid and gaseous targets by 40 MeV oxygen ion impact. (auth)

23876 (N-74-27218) CALCULATION OF TOTAL ELECTRON EXCITATION CROSS SECTIONS AND PARTIAL ELECTRON IONIZATION CROSS SECTIONS FOR THE ELEMENTS. Green, T. J. (Toledo Univ., Ohio (USA)). Dec 1973. 216p. (NASA-CR-138629). NTIS $14.00.

Thesis.

Computer programs were used to calculate the total electron excitation cross section for atoms and the partial ionization cross section. The approximations to the scattering amplitude used are as follows: (1) Born, Bethe, and modified Bethe for non-exchange excitation; (2) Ochkur for exchange excitation; and (3) Coulomb-Born of non-exchange ionization. The amplitudes are related to the differential cross sections which are integrated to give the total excitation (or partial ionization) cross section for the collision. The atomic wave functions used are Hartree-Fock-Slater functions for bound states and the coulomb wave function for the continuum. The programs are presented and the results are examined. (auth)

23877 THEORY OF RELAXATION DUE TO SPIN-EXCHANGE COLLISIONS. Medvedev, E. S. (AN SSSR, Moscow. Inst. Khimicheskoj Fiziki). Chem. Phys. (Amsterdam); 6: No. 2, 301-308(Nov 1974).

A general method is developed for the evaluation of the relaxation rates due to spin-exchange collisions. For the case where nuclear spin $I = \frac{1}{2}$, all the relaxation rates are found, account being taken of hyperfine and Zeeman interactions. The present theory can be applied to the following systems: (1) H + H, (2) H + a different electron-spin-$\frac{1}{2}$ atom, and (3) H + H_2. (auth)

23878 NEGATIVE IONS IN ELECTRON IMPACT EXCITATION OF He NEAR 60 eV. Ormonde, S.; Kets, F.; Heideman, H. G. M. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Phys. Lett., A; 50: No. 2, 147-148(18 Nov 1974).

An experimentally verifiable effect on the excitation cross section in helium due to the broad $(2s2p^2)^2S^e$He$^-$ state predicted by Fano and Cooper in 1965, but hitherto unidentified, and other He$^-$ states are predicted. (auth)

23879 H_2^- FORMATION IN ELECTRON IMPACT IONIZATION OF H_2 NEAR THRESHOLD. Boesten, L. G. J.; Heideman, H. G. M. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.); Schowengerdt, F. D.; Golden, D. E. (Nebraska Univ., Lincoln (USA). Behlen Lab. of Physics); Ormonde, S. (Quantum Systems Inc., Albuquerque, New Mexico 87108, USA). Phys. Lett., A; 50: No. 2, 144-146(18 Nov 1974).

New features in near-threshold ionization spectra of H_2, which can be correlated with two series of H_2^- states proceeding across the H_2^+ threshold, indicate a need for coincidence experiments that differentiate between one- and two-electron decay modes of H_2^-. (auth)

23880 SEMICLASSICAL S MATRIX THEORY FOR A COMPOUND STATE RESONANCE IN THE REACTIVE COLLINEAR H + H_2 COLLISION. Stine, J. R.; Marcus, R. A. (Illinois Univ., Urbana (USA). Dept. of Chemistry). Chem. Phys. Lett.; 29: No. 4, 575-579(15 Dec 1974).

The broad compound state resonance found in quantum mechanical calculations of the collinear H + H_2 reaction is shown to correspond semiclassically to multiple collisions of the atoms within the collision complex. The quantitative agreement between QM and SC results is quite reasonable. (auth)

23881 A COUPLED-STATES APPROXIMATION STUDY OF Li^+-H_2 COLLISIONS. Kouri, D. J.; McGuire, P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F.R. Germany)). Chem. Phys. Lett.; 29: No. 3, 414-417(1 Dec 1974).

The recently developed coupled-states approximation for describing atom–molecule collisions is applied in a slightly modified form to the Li^+-H_2 system. Due to the large anisotropy in the potential, a preferred orientation for rotational excitation exists which suggests the use of $l = J - j$ rather than $l = J$ as the angular momentum quantum number in approximating the eigenvalue of l^2 by $l(l + 1)$. Here, J and j are respectively the total and rotator angular momentum quantum numbers. The coupled-states integral and differential cross sections are compared with results of close-coupling calculations at 0.6, 0.9, and 1.2 eV. (auth)

23882 ELASTIC SCATTERING OF ELECTRONS BY HELIUM ATOMS. Jhanwar, B. L. (Meerut Univ. (India). Dept. of Physics); Khare, S. P. (Western Ontario Univ., London (Canada)). Phys. Lett., A; 50: No. 3, 201-202(2 Dec 1974).

By using Buckingham-type polarization potential with energy-dependent cut-off parameter, differential cross sections for the elastic scattering of electrons by helium atoms are obtained in the plane-wave approximation. Good agreement is found with experimental data and other sophisticated calculations without using any adjustable parameter. (auth)

23883 APPEARANCE OF UNIVERSAL MINIMA IN DIFFERENTIAL CROSS-SECTIONS FOR POTENTIAL SCATTERING OF HIGH ENERGY ELECTRONS IN PRESENCE OF A LIGHT BEAM. Faisal, F. H. M. (Bielefeld Univ. (F.R. Germany). Fakultaet fuer Physik). Phys. Lett., A; 50: No. 3, 193-194(2 Dec 1974).

Differential cross sections for potential scattering of high-energy electrons in presence of a light beam can vanish com-

pletely at definite angles of scattering whose positions are independent of the scattering atoms. Explicit values of such minimum scattering angles are calculated. (auth)

23884 DYNAMICAL THEORY OF INTERMEDIATE MOLECULAR PHENOMENA IN HEAVY ION SCATTERING. Smith, K.; Mueller, B.; Greiner, W. (Univ., Frankfurt am Main). J. Phys., B (London); 8: No. 1, 75-101(11 Jan 1975).

A general formulation of the collision between two heavy ions is presented. While this formalism may also be applied to nuclear structure problems, the emphasis is placed upon the electronic structure. Molecular and relativistic effects on the electronic motion are incorporated into the formalism through the two-center-many-body-Dirac equation. The various couplings of the electronic system to the nuclear system are illustrated in two cases. First the relative nuclear motion is treated quantum mechanically and then the semiclassical description of this motion is presented. The formalism is applied to inner shell vacancy production, molecular x-ray transitions, and both induced and autoionized positron spectra of the quantum electrodynamics of strong fields. Also induced and spontaneous and induced radiationless transitions are discussed. (auth)

23885 RADIATION PROCESS IN THE PASSAGE OF HEAVY CHARGED PARTICLE THROUGH AN ATOM. Raman, V. S. (Catholic Univ. of America, Washington, DC). J. Phys., B (London); 8: No. 1, 102-111(11 Jan 1975).

A process of radiative interaction between a fast moving, heavy, charged particle, N, and an atomic electron, e, moving with nonrelativistic velocities is examined. Formulas for cross sections for the process in which the electron is left in a continuum final state after the interaction and emission of a photon, γ, are presented. For collisions in which the heavy particle does not lose any sizeable fraction of its incident energy the amplitudes are calculated by methods of quantum electrodynamics. Analysis of the results is presented for the limiting cases of: soft photon emission; forward scattering of the electron and/or photon; scattering into a final state in which the initial momentum of N, and the final momenta of e and γ are coplanar. Various useful kinematic constraints are pointed out and used in these analyses for limiting values of energies of N, e and γ. (auth)

23886 TWO-CENTRE WAVEFUNCTIONS IN THE THEORY OF ELECTRON SCATTERING BY HYDROGEN ATOMS. Hunter, G.; Kuriyan, M. (York Univ., Toronto). Proc. Roy. Soc. (London), Ser. A; 341: No. 1627, 491-515(14 Jan 1975).

The scattering wave functions of the H^- ion are expanded in a basis of two-center wave functions with radial components. Two expansions are considered characterized by the charge ratio q being either -1 or +1. These expansions may be regarded as an extension of the polarized-orbital method. The q = +1 expansion has some novel features. The radial components are determined as the solutions of a set of coupled radial differential equations. Imposition of exchange antisymmetry transforms these equations into integro-differential equations for the q = -1 expansion, but for the q = +1 expansion the equations remain simply differential. The cross sections are determined by partial wave analysis, utilizing the Mathieu function form of the radial wave functions at moderately large values of R. Numerical work is reported based upon truncation of the q = +1 expansion after two terms. Phase shifts derived from static and adiabatic q = +1 potentials for the ι = 0 to 7 partial waves are presented for 59 values of the energy between 0 and 13.6 eV. The corresponding differential and total cross sections are compared with experimental, and other theoretical results. (auth)

23887 K X RAY PRODUCTION BY 90 TO 360 keV Ar AND Ne COLLISIONS WITH Si. Foster, C.; Hoogkamer, T.; Saris, F. W. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). J. Phys., B (London); 7: No. 18, 2563-2569(21 Dec 1974).

K x ray production in the collisions Ne^+, Ne^{++} — SiH_4; Si^+, Si^{++} — Ne, and Ar^{++} — SiH_4 was studied in the energy range 90 to 360 keV. Ar(K) and Si(K) x rays were looked for but not observed, and the production cross sections must be less than 10^{-23} cm^2, but Ne(K) x rays were found and the corresponding cross section increases between 10^{-24} and 3×10^{-22} cm^2 in the energy range studied, which agrees with expectations according to the electron promotion model of Fano and Lichten. Comparison was made of these ion-gas target results, with the previous ion-solid target results of Brandt and Laubert (Phys. Rev. Lett.; 24: 1037-40 (1970)) and Taulbjerf et al. (Phys. Rev.; 8: 1814-24 (1973)), and comment is made on the interpretation in terms of "solid effects". Within the framework of the Fano-Lichten model a rotational coupling of the $2p\sigma$MO to levels at or near the continuum is required to explain the present observation of Ne(K) x rays. (auth)

23888 REACTIONS OF IONS IN EXCITED ELECTRONIC STATES: $(N_2^+)^* + N_2 \rightarrow N_3^+ + N$. Bowers, M. T.; Kemper, P. R. (Univ. of California, Santa Barbara). J. Chem. Phys.; 61: No. 11, 4394-4399(1 Dec 1974).

The formation of N_3^+ ions from N_2^+ ions in an excited electronic state was studied using ion cyclotron resonance (ICR) spectroscopy. By analysis of the ICR data it was possible to determine the rate constant for formation of N_3^+ to be $k_3 = 5.5 \pm 1.0 \times 10^{-11}$ cm^3 sec^{-1}/$molecule^{-1}$, the lifetime of the precursor N_2^+* excited state to be $1/k_4 > 10^{-2}$ sec, and the ratio of active N_2^+* excited states to the remainder of the N_2^+* formed in the electron beam to be $k_2/k_1 = 10 \pm 1 \times 10^{-3}$. Comparison with previously published single source work and with optical studies of Holland and Maier indicate that at least two excited states of N_2^+* may be responsible for the formation of N_3^+ in the single source instruments, the A $^2\Pi$ state ($\tau \simeq 6 \times 10^{-6}$ sec) and a quartet state ($\tau \geq 10^{-2}$ sec). The onset of N_3^+ formation in the ICR is at 22.6 ± 0.6 eV, about 1.5 eV above the onset in the single source mass spectrometer. It is suggested the ICR onset corresponds to the onset of the active quartet state and the mass spectrometer onset to the thermodynamical onset of the N_3^+ ion. This analysis yields $\Delta H_f(N_3^+) = 372 \pm 4$ kcal/mole. (auth)

23889 NEAR THERMAL ENERGY CHARGE TRANSFER REACTIONS OF RARE GAS IONS WITH DIATOMIC AND SIMPLE POLYATOMIC MOLECULES: THE IMPORTANCE OF FRANCK-CONDON FACTORS AND ENERGY RESONANCE ON THE MAGNITUDE OF THE RATE CONSTANTS. Laudenslager, J. B. (California Inst. of Tech., Pasadena); Huntress, W. T. Jr.; Bowers, M. T. J. Chem. Phys.; 61: No. 11, 4600-4617(1 Dec 1974).

Charge transfer rate constants for reactions of He^+, Ne^+, Ar^+, Kr^+, and Xe^+ with N_2, O_2, CO, NO, CO_2, N_2O, and CH_4 were measured using an ion cyclotron resonance spectrometer. The absolute values of the rate constants were within the upper limit predicted from the Gioumousis-Stevenson orbiting theory for ion-molecule reactions. The magnitudes for the charge transfer rate constants are discussed with respect to the availability of an energy level of the molecular ion resonant with the combination energy of the rare gas ion, and the value of the Franck-Condon factor connecting this energy level of the molecular ion with the molecular neutral. (auth)

23890 CHARGE STATE EFFECTS IN HEAVY ION X-RAY PRODUCTION. Betz, H. D.; Bell, F.; Panke, H. (Univ., Munich). J. Phys., B (London); 7: No. 15, L418-L419(21 Oct 1974).

110 MeV sulphur ions with initial charge 11^+ and 15^+ are passed through thin copper foils. Yield ratios between Cu-K and projectile REC x rays elucidate mechanisms for the production of target x rays in fast heavy ion collisions. (auth)

23891 REPULSIVE PART OF THE POTENTIAL BETWEEN Hg ATOMS AND LIGHT ATOMIC PROJECTILES. Miremadi, B. Windsor, Ont.; Univ. of Windsor (1972). 93p.

Thesis.

Interatomic potentials between light atomic projectiles (^{1}H, ^{4}He, ^{11}B and ^{14}N) of keV energies and Hg atoms are studied by means of a crossed-beam apparatus. The measured angular distribution of the scattered projectiles includes all charge states. Deflections are studied in the angular range 17° θ_L 60° and in the energy range 5 E_L 70 keV, conditions for which all scattering events are violent ones; during which the electronic shells of the colliding atoms interpenetrate and the dominant part of the interaction is of a repulsive nature. Observed differential scattering cross sections are found to be in good agreement with theory for scattering in the Moliere potential, which, in the ranges studied, is shown to be a good approximation to the Thomas-Fermi potential between atoms. It is demonstrated that this theory can account for the repulsive interaction between light atomic particles. The measured scattering cross sections are also in good agreement with Professor Lindhard's theoretical estimates. (MGH)

23892 K-SHELL IONIZATION CROSS SECTIONS OF SELECTED ELEMENTS FROM Ag TO La FOR PROTON BOMBARDMENT FROM 0.6 TO 2.0 MeV. Khelil, N. A. Denton, TX; North Texas State Univ. (1974). 100p. University Microfilms Order No. 75-886.

Thesis (Ph. D.).

The K-shell x-ray and ionization cross sections were measured for protons on Ag, Cd, Sn, Sb, Te, Ba, and La over the ion energy range of 0.6 to 2.0 MeV. The data are compared to the predictions of the PWBA, the PWBA with corrections for binding energy and/or Coulomb deflection, the BEA, and the constrained-BEA predictions. In general, the nonrelativistic PWBA with binding energy correction gives the best overall agreement with the

measurements of proton-induced x-ray processes for the K-shell of the elements studied in this work. The data further suggest the need for relativistic PWBA treatment of the interactions in the K shell for the range of binding energies represented by the elements investigated in this work. (Diss. Abstr. Int., B)

23893 EXCITATION OF N V BY ELECTRON IMPACT. Henry, R. J. W. (Louisiana State Univ., Baton Rouge). J. Phys., B (London); 7: No. 16, L439-L442(11 Nov 1974).

Collision strengths for electron impact excitation of N v at an incident energy of 6.0 Ryd are calculated in a number of close-coupling approximations. Coupling effects are found to be more important than exchange effects for the 2s-3p transition, which result in a close-coupling collision strength 40% larger than that calculated in a distorted wave approximation by Flower (J. Phys. B. Atom. Molec. Phys.; 4: 697-705(1971)). For 2s-3s and 2s-3d transitions, exchange effects are more important than coupling effects, and the close-coupling and distorted wave results agree to within 13%. (auth)

23894 DISSOCIATIVE ELECTRON ATTACHMENT IN H_2O AND D_2O: ENERGY AND ANGULAR DISTRIBUTION OF H^- AND D^- FRAGMENTS. Trajmar, S.; Hall, R. I. (California Inst. of Tech., Pasadena). J. Phys., B (London); 7: No. 16, L458-L461 (11 Nov 1974).

The energy and angular distribution of H^- (D^-) produced by a dissociative attachment reaction of 6.5 eV electrons with H_2O(D_2O) was determined. The angular distribution of H^- peaks at 100° and the OH fragment is rotationally and, in a large part, vibrationally excited. (auth)

23895 ELECTRON CORRELATION AND THE $1^1S \rightarrow 2^1P$, 3^1P EXCITATION CROSS SECTIONS FOR He. Seddon, G. J.; Banyard, K. E. (Univ. of Leicester, Eng.). J. Phys., B (London); 7: No. 18, 2476-2488(21 Dec 1974).

Previously published values for the generalized oscillator strengths f(K) for the $1\ ^1S \rightarrow 2\ ^1P$ and $1\ ^1S \rightarrow 3\ ^1P$ excitations of He, calculated using noncorrelated and various orders of correlated wave functions, are employed to obtain total scattering cross sections for electrons, protons and hydrogen-like atoms as projectiles. Selected results for the corresponding excitations of an Li^+ target system are also presented. Within the first Born approximation, the behavior of cross sections derived from the "length" and "velocity" formulations of f(K) is examined as a function of the systematic introduction of electron correlation into the description of the ground state wave function for the target atom. Cross sections obtained from a noncorrelated wave function are found to be consistently too large when compared with the correlated results although the difference diminishes as the projectile energy is increased. The correlation trends for the scattering of atomic and nonatomic projectiles are similar in character but differ in magnitude. The use of an extensive configuration-interaction wave function for the $1\ ^1S$ state of He gave cross sections which agree closely with other calculations and with experiment. (auth)

23896 COMPLEX COORDINATE STUDIES OF RESONANT ELECTRON-ATOM SCATTERING. Bain, R. A. (Univ. of Pittsburgh); Bardsley, J. N.; Sukumar, C. V.; Junker, B. R. J. Phys., B (London); 7: No. 16, 2189-2202(11 Nov 1974).

Complex coordinates are used in the development of a variational principle for Siegert resonant states. The principle is first tested by application to a potential scattering problem. The position and width of the lowest ^1S resonance in e-H scattering are calculated to be 9.557 eV and 0.048 eV respectively. The corresponding values for the lowest ^2S resonance of He^- are 19.398 eV and 0.012 eV. (auth)

23897 HIGH RESOLUTION MEASUREMENTS OF P + Ar KLL AND KLM AUGER ELECTRONS. Mackey, J. J. (Univ. of Texas, Austin); Smith, L. E.; Johnson, B. M.; Moore, C. F.; Matthews, D. L. J. Phys., B (London); 7: No. 16, L447-L449 (11 Nov 1974).

Initial measurements of Ar KLL and KLM Auger electron lines produced by 4-MeV proton bombardment are reported. Energies and relative intensities of all observed peaks are tabulated. For the identifiable KLL transitions, the measured relative intensities are compared to theory. (auth)

23898 INFLUENCE OF COLLISIONAL TRANSFER OF EXCITATION ENERGY IN HELIUM ON THE ELECTRON-IMPACT EXCITATION OF THE 4^3D LEVEL. van Raan, A. F. J.; van Eck, J. (Rijksuniversiteit Utrecht). J. Phys., B (London); 7: No. 15, 2003-2020(21 Oct 1974).

Absolute apparent cross sections for electron-impact excitation of helium to the 4^3D level measured as a function of target-gas pressure ($3 \times 10^{-5} < p < 3 \times 10^{-3}$ Torr) were analysed by means of the "F-cascade model", proposed by St John and Fowler (Phys. Rev.; 122: 1813 (1961)), in order to study the process of collisional transfer in helium. Because resonance states play an important role, special attention is paid to imprisonment of resonance radiation. Furthermore it is found that scaling of the collisional transfer cross sections with a power of the principal quantum number n leads to results which are inconsistent with the experimental findings. By extrapolation of the apparent 4^3D cross section to zero pressure it is possible to estimate electron-impact excitation cross sections for the 4^1F level. (auth)

23899 COMPARISON OF ONE AND TWO CENTRE STUDIES OF LOW ENERGY SCATTERING BY DIATOMIC MOLECULES. Darewych, J. W. (Observatoire de Paris, Section de Meudon, France); Baille, P.; Hara, S. J. Phys., B (London); 7: No. 15, 2047-2054(21 Oct 1974).

From 8th ICPEAC; Belgrade, Yugoslavia (1973).

The elastic, momentum transfer and rotational excitation cross sections for low energy positrons scattered by hydrogen molecules are calculated using respectively, spherical and spheroidal coordinates and harmonic expansions. Both the spherical and the spheroidal calculations are done in the adiabatic-nuclei approximation. The harmonic expansions in the two coordinate systems are both truncated at corresponding order (up to and including d-waves). The calculations are identical, save for the fact that partial spherical analysis is used in one case and partial spheroidal analysis in the other. The two sets of results so obtained turn out to be almost identical. (auth)

23900 $P + H_2$ CHARGE TRANSFER COLLISIONS. Band, Y. B. (Univ. of Chicago). J. Phys., B (London); 7: No. 15, 2055-2071(21 Oct 1974).

A method for calculating charge exchange cross sections is generalized to provide a description of $p + H_2$ charge transfer processes. The assumptions and the conditions for the validity of the method are discussed. The results are compared with experiments on total charge transfer, capture into the 2S state of hydrogen, and capture into highly excited states. The relation between charge transfer from atomic hydrogen and H_2 are considered. Comparison with experiments and the predictions of Tuan and Gerjuoy (Phys. Rev.; 117: 756(1960)) is carried out. The excellent agreement with experiments, given the approximate treatment of the electronic structure of H_2, is explained by the strong cancellation between the proton-electron and proton-core interaction potential terms inside the H_2 core. (auth)

23901 TIME–DEPENDENT APPROACH TO SEMICLASSICAL DYNAMICS. Heller, E.J. (The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Chem. Phys. 62: No. 4, 1544-1555 (15 Feb 1975).

In this paper we develop a new approach to semiclassical dynamics which exploits the fact that extended wavefunctions for heavy particles (or particles in harmonic potentials) may be decomposed into time–dependent wave packets, which spread minimally and which execute classical or nearly classical trajectories. A Gaussian form for the wave packets is assumed, and equations of motion are derived for the parameters characterizing the Gaussians. If the potential (which may be nonseparable in many coordinates) is expanded in a Taylor series about the instantaneous center of the (many–particle) wave packet, and up to quadratic terms are kept, we find the classical parameters of the wave packet (positions, momenta) obey Hamilton's equation of motion. Quantum parameters (wave packet spread, phase factor, correlation terms, etc.) obey similar first-order quantum equations. The center of the wave packet is shown to acquire a phase equal to the action integral along the classical path. State–specific quantum information is obtained from the wave packet trajectories by use of the superposition principle and projection techniques. Successful numerical application is made to the collinear $He + H_2$ system widely used as a test case. Classically forbidden transitions are accounted for and obtained in the same manner as the classically allowed transitions; turning points present no difficulties and flux is very nearly conserved. (auth)

23902 SEMICLASSICAL THREE–DIMENSIONAL MODEL FOR VIBRATIONAL RELAXATION. II. Billing, G.D. (Chemistry Laboratory III, H. C. Ørsted Institute, 2100 Copenhagen Ø, Denmark). J. Chem. Phys. 62: No. 4, 1480-1487 (15 Feb 1975).

A three–dimensional semiclassical model for vibrational/rotational transitions has been extended to include an infinite order treatment of the rotational transitions. An analytical expression for the transition probabilities is obtained by using an effective potential and a simple collision trajectory. Numerical results for the Ar–N_2 and the $I_2(B^3\Pi_{0u^+}) + He^4$ systems have been obtained. (auth)

23903 CHARGE TRANSFER CROSS SECTIONS FOR METASTABLE $N^+(^1D)$ IN COLLISION WITH KRYPTON AND CARBON MONOXIDE. Rutherford, J.A.; Vroom, D.A. (Intelcom

Rad Tech, San Diego, California 92138). J. Chem. Phys. 62: No. 4, 1460-1462 (15 Feb 1975).

Cross sections for the exothermic charge transfer processes involving ground and metastable N^+ ions and Kr and CO have been obtained in the energy range from 1–500 eV. For both target species, the cross section for the metastable ion is larger than for the ground state in the low ion energy region. This difference is explained by the availability of excited product states which can carry away the exothermicity of the reaction. The method used to determine the fraction of metastable N^+ ions present in the primary ion beam is discussed. (auth)

23904 DELTA–FUNCTION MODEL FOR SHORT–RANGE INTERATOMIC FORCES: CORRELATION SCHEME FOR CLOSED–SHELL ATOMS AND IONS. Sondergaard, N.A.; Mason, E.A. (Brown University, Providence, Rhode Island 02912). J. Chem. Phys. 62: No. 4, 1299-1302 (15 Feb 1975).

A correlation scheme is developed for the short–range interaction energies between rare–gas atoms and positive and negative ions with rare–gas configurations. The exponential form of the correlation and the relation between the exponential and pre-exponential constants are predicted by a delta–function model. The exponential constants are found to correlate with the softness parameters obtained from Hartree–Fock–Slater calculations on single atoms and ions. Comparisons are made with experimental beam scattering data, *ab initio* quantum–mechanical calculations, and the electron–gas model of Gordon and Kim. The over–all agreement is good. (auth)

23905 BORN–LIKE SCALING OF ELASTIC ELECTRON SCATTERING CROSS SECTIONS FOR ELEMENTS NEAR $Z = 79$ AT 200–500 eV. Riley, M.E. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Chem. Phys. 62: No. 4, 1337-1339 (15 Feb 1975).

The elastic, electron–Hg scattering measurements of Bromberg show a Born–like scaling in the 200–500 eV energy range. The calculations presented here show that this scaling is present in the static approximation and that the general feature is a shoulder in the energy dependence of the small–to–moderate–momentum–transfer differential cross section. This shoulder for Hg is predicted to be a part of a general structure in the elastic, electron–scattering cross sections for elements near Au in the periodic table. (auth)

23906 VIBRATIONAL EXCITATION IN THE DECENT APPROXIMATION: THE LARGE–ANGLE SCATTERING OF Li^+ FROM H_2. Gentry, W.R. (Chemical Dynamics Laboratory, Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455); Giese, C.F. J. Chem. Phys. 62: No. 4, 1364-1371 (15 Feb 1975).

We have applied the DECENT model, which exploits the correspondence between the classical and quantal equations of motion for a forced harmonic oscillator, to the calculation of quantum vibrational transition probabilities and differential cross sections for large–angle scattering of Li^+ from H_2, using the Lester potential energy hypersurface. The results are in good agreement with the experimental data of David, Faubel, and Toennies, but they show the necessity for taking into account concurrent rotational excitation, which has not yet been resolved experimentally in this energy and scattering angle regime. If the trajectories are calculated using the spherically averaged potential, rather than the results obtained first using the full anisotropic potential and then orientation–averaged, the same angle dependence of the classical differential cross section is obtained, but the vibrational transition probabilities are severely underestimated. A collinear trajectory also gives very small vibrational excitation energy. We show that large vibrational excitations are associated with a particular class of noncollinear trajectories in which the vibrational and rotational motions are strongly coupled. The vibrational excitation process can therefore be adequately described only by a three–dimensional calculation using the complete potential energy hypersurface, including anisotropic terms. (auth)

23907 STUDIES OF INELASTIC MOLECULAR COLLISIONS USING IMPACT PARAMETER METHODS. I. MODEL CALCULATIONS. Fisanick–Englot, G.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08540). J. Chem. Phys. 62: No. 4, 1409-1424 (15 Feb 1975).

In this paper we explore the behavior of an exponential approximation to the impact parameter amplitudes for model systems with potential matrices of simple form. In these matrices the magnitude of the coupling is governed by the difference in the quantum numbers of the coupled states. In the limit of large numbers of states the amplitude functions may be expressed as single integrals, which in many cases can be evaluated in terms of known mathematical functions. The simple structure of this result allows us to analyze the general features of the amplitude functions and the resulting cross section integrands *versus* impact parameter. Specific examples for potentials with Gaussian and exponential radial dependence are used for illustration. An exploration of the effect of varying the potential parameters for the Gaussian potential is made. In addition, the behavior of functions related to the generalized cross sections for spectral line broadening are considered. Finally, we explore the generalization of the simple model to more elaborate coupling schemes. (auth)

23908 RELATIVITY AND SCREENING EFFECTS IN HEAVY–ION COLLISIONS. Fricke, B. (Gesamthochschule Kassel, 35 Kassel, Germany); Rashid, K.; Bertoncini, P.; Wahl, A.C. Phys. Rev. Lett. 34: No. 5, 243-246 (3 Feb 1975).

Diatomic correlation diagrams are the main basis for the description of heavy–ion collisions. We have constructed the first realistic relativistic many–electron correlation diagrams based on nonrelativistic self–consistent–field, Hartree–Fock calculations of diatomic molecules plus relativistic corrections. We discuss the relativistic influences as well as the many–electron screening effects in the I–Au system with a combined charge of $Z=132$ as an example. (auth)

23909 SUDDEN REARRANGEMENTS IN INTERMEDIATE MOLECULAR SYSTEMS. Smith, R.K.; Müller, B.; Greiner, W. (Institut für Theoretische Physik der Johann Wolfgang Goethe–Universität, Frankfurt am Main, Germany); Greenberg, J.S.; Davis, C.K. Phys. Rev. Lett. 34: No. 3, 117-120 (20 Jan 1975).

Intensity oscillations are observed in the quasimolecular K x–ray spectrum emitted in high–energy $^{58}Ni–^{58}Ni$ collisions. The oscillating structure is shown, theoretically, to reflect the existence of a two–step mechanism for the production of molecular–orbital K x rays in which sudden rearrangements of molecular–orbital populations are produced by vibrations between atomic and molecular orbitals of K–hole states during the interpenetration of the electronic clouds. (auth)

23910 SUM RULES FOR PHOTON SCATTERING FROM BOUND ATOMIC SYSTEMS. King, F.W. (Chemistry Department, Queen's University, Kingston, Ontario, Canada, K7L 3N6). Phys. Rev. A 11: No. 1, 381-382 (Jan 1975).

Sum rules for the forward elastic scattering of photons from bound atomic systems are obtained from the appropriate dispersion relations and the nontrivial zeros of the scattering amplitude. The significance of these sum rules for photon scattering from the hydrogenic atoms is outlined. (auth)

23911 ELECTRON EXCITATION OF THE $2s$ AND $2p$ STATES OF HYDROGEN FROM THRESHOLD TO 50 eV. Pindzola, M.S.; Kelly, H.P. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. A 11: No. 1, 221-229 (Jan 1975).

The $2s$ and $2p$ excitation cross sections for electron scattering on hydrogen in the energy range from threshold to 50 eV are calculated by two similar methods. The distorted–wave method using Hartree–Fock continuum wave functions in the frozen–core approximation is applied. The effect of calculating the distorted waves in the potential of the initial or final state is investigated. The imaginary part of the optical potential, or self–energy of the single–particle Green's function, is also calculated in lowest order by the use of many–body diagrams. Comparison is made with recent experimental results. (auth)

23912 LOW–ENERGY ELECTRON SCATTERING BY ATOMIC OXYGEN. Thomas, L.D.; Nesbet, R.K. (IBM Research Laboratory, San Jose, California 95193). Phys. Rev. A 11: No. 1, 170-173 (Jan 1975).

A matrix variational calculation has been done for electron scattering by atomic O, which includes $2s^22p^4$, $2s2p^5$, and $2p^6$ target configurations and all possible single excitations of the $2p$ orbital. Integral and differential cross sections are reported for elastic and inelastic scattering for energies up to the first $n = 3$ excitation threshold. The full effects of long–range polarization and short–range correlation appear to be nearly completely accounted for. No low–lying resonances are observed. (auth)

23913 STRUCTURES IN THE ELECTRON TRANSMISSION SPECTRUM OF H_2 NEAR THE H_2^+ THRESHOLD. Schowengerdt, F.D.; Golden, D.E. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68508). Phys. Rev. A 11: No. 1, 160-165 (Jan 1975).

The energy dependence near the ionization threshold of the electron–scattering cross section of H_2 has been investigated. Two series of structures which proceed across the H_2^+ threshold have been observed which can be correlated with structures observed previously in the ionization efficiency function. These results suggest that in the threshold region a significant portion of the ionization process by electron collision proceeds via the various decay modes of temporary H_2^- states. Furthermore, these structures can also be correlated with some structures in the photoionization cross section. Those H_2^- states that decay to autoionizing levels of H_2 and then to H_2^+ may account for the correlation with some of the photoionization data. To differentiate experimentally between one– and two–electron decay modes of H_2^- leading to H_2^+ formation, coincidence experiments between H_2^+ ions and electrons with specific energy losses will be necessary. (auth)

23914 SEMICLASSICAL CALCULATION OF REGGE POLES. Delos, J.B.; Carlson, C.E. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). Phys. Rev. A 11: No. 1, 210-220 (Jan 1975).

We have calculated the locations of the Regge poles for an actual interatomic potential by following the semiclassical formulation. For negative energies, this formulation is equivalent to the Bohr–Sommerfeld quantization condition. For positive energies there are three complex turning points; use of linear and parabolic connection formulas yields a semiclassical quantization condition for the poles. The poles are found to lie symmetrically along lines in the first and third quadrants of the angular–momentum plane. The locations of the poles at a given energy and the motion of these poles as the energy changes are presented. Remler has shown that Regge poles provide a convenient way of parametrizing experimental differential cross sections. We discuss the relation between this parametrization and the present results. (auth)

23915 RIGOROUS STATIONARY BOUNDS ON e^-–ATOM SCATTERING LENGTHS: TARGET GROUND–STATE WAVE FUNCTIONS IMPRECISELY KNOWN. Blau, R.; Rosenberg, L.; Spruch, L. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 11: No. 1, 200-209 (Jan 1975).

In recent work, the existence of stationary bounds on bound–state matrix elements for rather broad classes of quantum–mechanical operators was used to obtain a stationary upper bound on the scattering length for the collision of positrons with atoms whose target wave functions are not precisely known. This was done by obtaining calculable stationary bounds on the unknown matrix elements which appear in the formal expression for the bound on the scattering length. This method is extended in the present paper to electron–atom scattering for which it is necessary to obtain—in addition to bounds of the previous type—stationary bounds on the various exchange integrals. These latter cannot be obtained by means of techniques previously described. New techniques are presented for deriving such bounds, which are then used to obtain rigorous stationary upper bounds on the scattering length for the collisions of electrons with helium and with atoms heavier than helium. (auth)

23916 *K* x–RAY PRODUCTION IN SINGLE COLLISIONS OF CHLORINE AND SULFUR IONS. Winters, L.; Brown, M.D.; Ellsworth, L.D.; Chiao, T.; Pettus, E.W.; Macdonald, J.R. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 11: No. 1, 174-187 (Jan 1975).

Cl *K* x–ray–production cross sections have been measured in single collisions of 0.1–1.5–MeV/amu Cl ions with gas targets of He, N_2, Ne, SiH_4, H_2S, HCl, Ar, Kr, and Xe. Cross sections for Ne *K*, Si *K*, S *K*, Ar *K*, Kr *L*, and Xe *L* x–ray production and yields for Xe *M* x rays were also obtained. Similar measurements for both Cl and S ions were made at one velocity as a function of projectile charge state q for $5 \leq q \leq 11$. Except at the highest energies, projectile *K* x–ray–production cross sections are nonmonotonic as a function of target atomic number Z_2. Anomalously high target and projectile cross sections occur in the symmetric region: $Z_2 \simeq 17$. For all x–ray lines, the cross sections show an increase with increasing q at constant projectile velocity, with the rate of increase being greatest in the symmetric region. The experimental results indicate the importance of one–step molecular processes suggested by Meyerhof in producing *K* vacancies. The $2p\sigma - 2p\pi$ transition may be of importance when initial $2p$ vacancies are carried into *K*–vacancy–producing collisions. The large cross sections for both target and projectile in nearly symmetric collisions gives evidence for *K*-vacancy transfer between collision partners. (auth)

23917 ELECTRONIC EXCITATION IN COLLISIONS OF H AND H^+ WITH O_2. Birely, J.H. (Chemistry and Physics Laboratory, The Aerospace Corporation, El Segundo, California 90245). Phys. Rev. A 11: No. 1, 79-86 (Jan 1975).

The 115–750–nm radiation produced in collisions of 1.5–25–keV H^+ and H with O_2 has been studied in an atomic–beam experiment under thin–target conditions. Both for ion and neutral impact, the ($b\ ^4\Sigma^-_g - a\ ^4\Pi_u$) first–negative ($1N$) and ($A\ ^2\Pi_u - X\ ^2\Sigma^+_g$) second–negative ($2N$) band systems of O^+_2 are the most intense spectral features. Also observed are several emissions from excited states of O and O^+. Relative cross sections for individual bands of the O^+_2 $1N$ system, obtained by deconvolution of overlapped features in several vibrational sequences, were used to show that the vibrational population $P(v')$ for O^+_2 $b\ ^4\Sigma^-_g$ formed in both H^+ and H impact is in good agreement with the predictions of a simple Franck–Condon mechanism over the 2–25 keV energy range. Total cross sections for formation of O^+_2 $b\ ^4\Sigma^-_g$ in H^+ and H impact, determined from the latter results by normalization to previous proton impact data, are in good agreement with values calculated via application of the semiempirical procedure developed recently by Edgar *et al.* For both projectiles the semiempirical approach gives a good prediction of the energy dependence and an adequate prediction of the magnitude of the cross sections for formation of O^+_2 $A^2\Pi_u$ determined by integration of measured $2N$ band intensities. (auth)

23918 ANALYSIS OF THICK–TARGET x–RAY YIELDS. Garcia, J.D. (Physics Department, University of Arizona, Tucson, Arizona 85721). Phys. Rev. A 11: No. 1, 87-89 (Jan 1975).

The problem of extraction of cross–section information from thick–target x–ray yields is considered for the case of heavy projectiles having internal states. In particular, an analysis is carried out for the situation in which the projectile must carry an inner–shell vacancy into the collision in order to produce excitation of the target atom. It is found that the usual thick–target yield analysis, involving one derivative of the yield with respect to incident projectile energy, does not apply in this case. Explicit expressions are derived for obtaining cross–section information from the yield data. (auth)

23919 APPLICATION OF A CLASSICAL TRAJECTORY MODEL TO VIBRATIONAL EXCITATION IN HIGH–ENERGY $H^+ + H_2$ COLLISIONS. Gentry, W.R. (Chemical Dynamics Laboratory, Chemistry Department, University of Minnesota, Minneapolis, Minnesota 55455); Giese, C.F. Phys. Rev. A 11: No. 1, 90-96 (Jan 1975).

The method of distribution among quantum states of exact classical energy transfer (the DECENT model) for vibrational excitation in molecular collisions, in which three–dimensional classical trajectories are used to evaluate the quantum vibrational transition probabilities, is applied to $H^+ + H_2$ and $D^+ + H_2$ collisions at relative kinetic energies between 35 and 1000 eV. We compare the results with the experimental data of Herrero and Doering. Taking into account the scattering–angle discrimination in the experimental measurements, we find good agreement with experiment for the shapes of the energy dependence of the calculated total cross sections for individual final vibrational states and for the cross–section ratios. The absolute magnitudes of the calculated vibrational–excitation cross sections at high energies are about a factor of 2 larger than the experimental values, probably because of electronically nonadiabatic behavior ignored in the calculation, but a systematic discrepancy exists at lower energies which cannot be completely reconciled with the available experimental information. (auth)

23920 LOW–ENERGY Ar^+, Kr^+, Xe^+ + K, Rb, Cs CHARGE–TRANSFER TOTAL CROSS SECTIONS. Ice, G.E.; Olson, R.E. (Molecular Physics Department, Stanford Research Institute, Menlo Park, California 94025). Phys. Rev. A 11: No. 1, 111-118 (Jan 1975).

Asymmetric charge–transfer total cross sections have been calculated for the reaction $X^+ + Alk \rightarrow X^0 + Alk^+$, where *X* represents Ar, Kr, or Xe and Alk represents K, Rb, or Cs. The calculations were performed at low velocities, $v \sim 1 \times 10^6$ cm/sec, using a modified method of Demkov and semiempirical coupling matrix elements. The Ar results are compared with the experimental data of Peterson and Lorents and agreement is found in the total cross–section shape, but there is an increasing underestimation of the cross section with the higher–atomic–weight alkali–metal atoms. This problem is attributed to the importance of rotational coupling to the p–state levels of the excited noble–gas products, suggesting more accurate cross sections for Kr and Xe, where the contribution from the p states will be of lesser importance. Large cross sections are predicted for direct production of the metastable noble gas in the lowest–lying $^3P_2$ state for the reactions Ar^+ + Rb, Kr^+ + Rb, and Xe^+ + Cs. (auth)

23921 *M*–SHELL IONIZATION OF Au, Bi, AND U BY PROTONS AND HELIUM IONS IN THE MeV REGION. Ishii, K.; Morita, S. (Department of Physics, Tohoku University, Sendai, Japan); Tawara, H.; Kaji, H.; Shiokawa, T. Phys. Rev. A 11: No. 1, 119-124 (Jan 1975).

The *M*–shell x–ray production cross sections in Au, Bi, and U were measured with a Si(Li) detector for proton and ^{3}He–ion bombardments over the energy range 1.0–4.5 MeV and 3.0–9.0 MeV, respectively. Absolute ionization cross sections are derived and compared to the predictions of the binary–encounter approximation (BEA) and the plane–wave Born approximation (PWBA). Systematic deviation of the experimental results from the scaled universal curve of the BEA is found. It is shown that this deviation can be understood by taking into account the velocity distribution function for the $3d$ electrons. Good agreement between the PWBA calculation of Choi and the experimental results is obtained for the *M*–shell ionization of Au. The ratios of the ionization cross sections for proton bombardment to those for helium–ion bombardment, at equal velocities, deviate substantially from the theoretical Z^2_1 dependence and show so–called crossover behavior, which has been found for the *K*– and *L*–shell ionization. (auth)

23922 SYMMETRIC ION–ATOM COLLISIONS AT MEDIUM ENERGIES. CHARACTERISTIC x RAYS. Laubert, R.; Haselton, H.; Mowat, J.R.; Peterson, R.S.; Sellin, I.A. (University of Tennessee, Knoxville, Tennessee 37916 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 11: No. 1, 135-139 (Jan 1975).

We report the characteristic *K*–shell x–ray production cross sections for Al ions (500 keV to 40 MeV) incident on thin, solid Al targets and for Ni ions (10–63 MeV) incident on thin, solid Ni targets. In these energy regions the transition from predominately quasimolecular excitation to predominantly Coulomb excitation occurs. For incident

Al—ion energies up to ~10 MeV the experimental cross sections are predicted reasonably well by deuteron—deuteron cross sections, scaled according to a recipe provided in a model of Briggs and Macek. For higher incident Al—ion energies the reported cross sections fall below the predicted results given by the modified plane—wave Born approximation and probably reflect the dependence of the x—ray cross section on the charge of the incident ion. (auth)

23923 MEASUREMENT OF THE CROSS SECTION FOR CHARGE TRANSFER INTO THE STATES H(3*s*) AND H(4*s*) FOR H^+ AND D^+ INCIDENT ON H_2, N_2, AND O_2. Loyd, D.H.; Dawson, H.R. (Department of Physics, Angelo State University, San Angelo, Texas 76901). Phys. Rev. A 11: No. 1, 140-145 (Jan 1975).

The energy dependence of the cross section for charge transfer into the H(3*s*) and H(4*s*) states for H^+ and D^+ incident on H_2, N_2, and O_2 exhibits deviation from the form $\sigma = A \exp(-Ks|\Delta E|/h\nu)$ predicted by the adiabatic criterion in the range 1.2—8.2 keV. Analysis of the present data and other previously reported cross sections for protons incident on Ar, He, and Ne reveal some secondary maxima in the 2*s*, 3*s*, and 4*s* cross sections. Correlations between the structure in these cross sections and maxima in the total and 2*p* cross sections suggest intermediate—state coupling as an explanation for the observed structure. (auth)

23924 ROLE OF OUTER SHELLS IN BORN CROSS SECTIONS FOR *K*—SHELL IONIZATION BY CHARGED PARTICLES. McGuire, J.H.; Macdonald, J.R. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 11: No. 1, 146-148 (Jan 1975).

Many standard applications of the Born approximation to *K*—shell vacancy production apply first—order perturbation theory to the interaction between a projectile and an atomic target represented by a product wave function. It is shown that these standard Born predictions need not be restricted to one—electron ionization, but should be compared to experimental observations summed over all states corresponding to single—*K*—vacancy production to include multiple—vacancy production in other shells. These results are applicable to all targets in which the *K* shell is weakly perturbed even though the other shells may be strongly perturbed. (auth)

23925 SEMICLASSICAL NORMALIZATION OF A PATH INTEGRAL FOR A MULTICHANNEL SCATTERING PROBLEM. Penner, A.P.; Wallace, R. (Department of Chemistry, University of Manitoba, Winnipeg, Manitoba, Canada). Phys. Rev. A 11: No. 1, 149-153 (Jan 1975).

The evaluation of a Feynman path integral is discussed for a scattering problem in which some degrees of freedom of the system are treated classically, while others are treated quantum mechanically. The path integral is of the type K(O,t'';O,t'), and is of interest in a multichannel semiclassical collision theory previously developed by Pechukas. It is shown that this path integral can be evaluated precisely in practice, despite the presence of noncausal terms in the integrand. (auth)

23926 ELECTRON TRANSFER IN ATOMIC COLLISIONS. Ivanov, G.K. Opt. Spectrosc. (USSR) 37: No. 4, 361-364 (Oct 1974).

The interaction of an atom containing a weakly bound electron with neutral particles (atoms and molecules) is investigated using the equations for the level shift operator and the quasi—classical simplifications of Green's function. Asymptotically exact expressions are obtained for the potential of the finite radius of action. They describe the interaction of covalent states with the ionic state. The results obtained are also applicable in cases that are not encompassed by the known point potential model. A theoretical analysis is made of the experimentally investigated processes of the formation of negative ions in collisions of potassium atoms with O_2 and Cl_2 molecules. Taking into account the finite value of scattering phases, a spectroscopic formula is obtained for the shift of the optical line of a highly excited atom in foreign gas. (auth)

23927 TABLES OF CROSS SECTIONS FOR ION—ATOM RESONANT CHARGE EXCHANGE. Duman, E.L.; Smirnov, B.M. (I. V. Kurchatov Atomic Energy Institute). High Temp. 12: No. 3, 431-436 (Jan 1975).

On the basis of an asymptotic method, the cross sections for resonant charge exchange with the participation of positive and negative ions are calculated for 68 atoms of the Mendeleev table having outer *s* and *p* electrons. The cross sections correspond to energies of the incident ion ranging from 0.1 to 10^3 eV. The accuracy of the calculated cross sections is estimated to be not worse than 10%. (auth)

23928 ABSOLUTE CROSS SECTIONS FOR THE EXCITATION OF THE $1s_2$- AND $1s_4$-LEVELS OF NEON AND ARGON BY PROTON IMPACT (100 keV TO 1,150 keV). Hippler, R.; Schartner, K. H. (Giessen Univ. (F. R. Germany). 1. Physikalisches Inst.). Z. Phys.; 270: No. 3, 225-228(Oct 1974).

The excitation of the $1s_2$ and $1s_4$ levels in neon and argon has been studied by proton impact in the energy range of 100 to 1,150 keV. The results are compared with other experimental and theoretical data. (auth)

23929 PHASE SHIFT ANALYSIS OF ELECTRON-ATOM SCATTERING. V. Revised (1973) Results for Helium and Neon. Naccache, P. F.; McDowell, M. R. C. (Royal Holloway Coll., London). J. Phys., B (London); 7: No. 16, 2203-2222(11 Nov 1974).

A phase shift analysis of electron-helium scattering in the energy range from 10^{-2} to 10^2 eV, and of electron-neon scattering from 3×10^{-2} to 60 eV is reported, using new measurements of the elastic differential cross sections by McConkey and Preston (Proc. 8th Int. Conf. on Phys. of Electronic and Atomic Collisions. Belgrade. Abs vol. 1 p.273 (1973)). Error estimates are assigned to the derived s, p, and d wave phase shifts for electron-helium scattering, and the conjectured dispersion relation further tested. The results of the analysis of electron-neon scattering remain in good agreement with adiabatic-exchange theory, though the s-wave phase shift shows anomalous behavior at intermediate energies. Estimates of the imaginary part of the optical potential are obtained for both systems. (auth)

23930 PRODUCTION OF LYMAN-ALPHA RADIATION IN H(2S)-H_2 COLLISIONS. Dose, V.; Hett, W. (Univ., Wuerzburg, Ger.). J. Phys., B (London); 7: No. 16, L454-L457(11 Nov 1974).

Relative cross sections for the production of Lyman-alpha radiation in collisions of atomic metastable hydrogen with molecular hydrogen were measured at twenty-five velocities between 6×10^5 and 3×10^6 cm s^{-1}. The measurements were carried out using time of flight techniques in combination with a recently developed target pressure modulation. Results for the Lyman-alpha emission cross section exhibit the same velocity dependence as the total destruction cross section obtained by the authors (Dose and Hett J. Phys. B. Atom. Molec. Phys.; 7: 479-81 (1974)) and are in complete disagreement with earlier measurements of Comes and Wenning (Z. Naturf.; A24: 387-96 (1969)). (auth)

23931 ENERGY DISTRIBUTION CROSS SECTION IN THRESHOLD ELECTRON-ATOM IMPACT IONIZATION. Temkin, A. (National Aeronautics and Space Administration, Greenbelt, MD). J. Phys., B (London); 7: No. 16, L450-L453(11 Nov 1974).

The flatness of the energy differential cross section in impact ionization is derived analytically in the Wannier theory (Phys. Rev.; 90: 817-25(1953)). However it is shown that the Wannier zone is confined to a region of the order $E/5 < \epsilon < 4E/5$, where E is the available energy and ϵ is the energy of one of the electrons. By contrasting the known results of photoionization and photodetachment, one can cogently argue that in the complementary region where the electrons share their energy very unequally the cross section rises to a value independent of E (aside from a modulation factor) and that this region determines the form of the threshold law. (auth)

23932 PHASE SHIFT ANALYSIS OF ELECTRON-ATOM SCATTERING. VI. Scattering by Mercury at Low Energies. Hutt, P. K.; Bransden, B. H. (Univ. of Durham, Eng.). J. Phys., B (London); 7: No. 16, 2223-2229(11 Nov 1974).

A phase shift analysis was made of elastic electron-mercury scattering in the energy range below the inelastic threshold, 0.5 to 4.5 eV. Varying the 0, 1^1, 2^1, 3^1 phase shifts a good simultaneous fit to the polarization, differential cross section and total cross section could not be found, apparently because of inconsistencies between the various sets of experimental data. In particular, it appears that the available measurements of the total cross sections are in error. The computed phase shifts agree reasonably with the relativistic, polarized orbital calculation of Walker (J. Phys. B. Atom. Molec. Phys.; 3: 788-97 (1970)), at 3.5 eV, but not with calculations made without allowance for atomic distortion. (auth)

23933 HUND'S COUPLING SCHEME IN THE THEORY OF FINE STRUCTURE TRANSITIONS IN ATOM—ATOM COLLISIONS: APPLICATION TO Na(3p)-He COLLISIONS. Masnou-Seeuws, F. (Observatoire de Paris, Section de Meudon, France); McCarroll, R. J. Phys., B (London); 7: No. 16, 2230-2243(11 Nov 1974).

The mechanism of fine structure transitions in atom-atom collisions is discussed, within the framework of the molecular representation, in terms of the evolution of the colliding system from one Hund's coupling case to another. In the case where the change of coupling can be considered as sudden, very simple models of the process can be constructed. The results, obtained with such models, are compared in the case of Na(3p)-He collisions with the results of exact calculations. Choosing the molecular potentials given by Nikitin (J. Chem. Phys.; 45: 2671-81 (1965)) or by Bottcher (Chem. Phys. Lett.; 18: 457-9 (1973)) and taking into account trajectory effects, the calculated cross sections are in

close agreement with experiment. The discrepancy with the quantal results of Reid (J. Phys. B.; Atom. Molec. Phys.; 6: 2018-39 (1973)), which is about 20% for the fine structure transition, is primarily due to the use of different potential and to trajectory effects. (auth)

Atomic Theory

23934 (CONF-730660-P1, pp A1-A16) GROUP THEORY AND ATOMIC PHYSICS. Armstrong, L. Jr. (CNRS, Orsay, France). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The uses of group theory in atomic physics are reviewed, with special emphasis on atomic structure. Starting from the general transformation properties of fermion creation and annihilation operators, a large number of noninvariance groups of the atomic hamiltonian can be constructed; it is shown that these groups are extremely useful, not only for the labeling of atomic states, but also for describing the transformation properties of hamiltonian operators. Knowledge of these transformation properties is shown to facilitate the analysis of complex spectra through the introduction of effective operators. The role of noncompact groups in atomic structure is discussed. (auth)

23935 (CONF-730660-P2, pp B31-B43) WIGNER COEFFICIENTS AND TENSOR OPERATORS FOR ANY FINITE OR COMPACT GROUP. Butler, P. H. (Univ. of Toronto). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The action of an arbitrary finite or compact group on an arbitrary Hilbert space was studied. This was used to define Clebsch Gordan (Wigner) coefficients and to discuss their properties and uses. The most important use is through the Wigner-Eckart theorem. This theorem is deduced by studying the space of braket operators and finding a basis for this space in terms of operators with standard transformation properties—emphasis is placed on the case when properties are fixed by the action of the group, and when phases or linear combinations may be chosen arbitrarily. (auth)

23936 FRACTIONAL PARENTAGE COEFFICIENTS FOR EQUIVALENT f SHELL ELECTRONS. Allison, D. C. S.; McNulty, J. E. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics). Comput. Phys. Commun.; 8: No. 3, 246-256(Oct 1974).

The CFPF package evaluates the Racah coefficients of fractional parentage for equivalent f-shell electrons. These coefficients are defined by $(f^n \alpha SL \| f^{n-1} \alpha' S' L', f\, SL)$ where n denotes the number of equivalent electrons and S, L; S′L′ are respectively the total spin and total orbital angular momentum quantum numbers of the state in question and its parent state. The parameters α and α' are labels which are used to identify the remaining quantum numbers which are necessary for the unambiguous classification of the multiplets f^n and f^{n-1}. Racah has shown that fractional parentage coefficients may be factored if the states to which they refer correspond to the group theoretical classification scheme. In the case of the f shell, the fractional parentage coefficients are the product of three factors. In this program all the possible factors arising in the calculation were encoded in tabular form and placed in a block data segment. When all the quantum numbers of the state in question and its parent state were identified, the corresponding fractional parentage coefficient was found by searching through each of three tables to pick out the required factors. (auth)

23937 A GENERAL PROGRAM TO CALCULATE ATOMIC CONTINUUM PROCESSES USING THE R-MATRIX METHOD. Berrington, K. A.; Burke, P. G.; Chang, J. J.; Chivers, A. T.; Robb, W. D.; Taylor, K. T. (Queen's Univ., Belfast, Northern Ireland (UK). Dept. of Applied Mathematics). Comput. Phys. Commun.; 8: No. 3, 149-198(Oct 1974).

This program calculates all one-electron, two-electron and multipole radial integrals involving the bound and continuum orbitals necessary to enable electron–atom or –ion scattering, photoionization or frequency-dependent polarizabilities to be calculated for a general atomic system. The bound orbitals are specified analytically. The continuum orbitals are calculated by the program. The integrals are stored on a permanent tape or disc file for use by RMATRX STG2, which calculates the hamiltonian matrix elements and other quantities. These are then read by a third program which calculates the cross sections or frequency-dependent polarizabilities. (auth)

23938 IMPOSSIBILITY OF ROTATIONAL BAND PRESENCE IN THE ENERGY SPECTRUM OF THE O BOHR–MOTTELSON THEORY. Nevzglyadov, V. G. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 216: No. 1, 63-66(1 Mar 1974). (In Russian).

It is shown that in the generalized case of the Bohr–Mottelson theory when β and γ are variable, the spectra of the equidistant and rotational bands can not be obtained because they are the result of irrotational movement. (JSR)

23939 CONTEMPORARY THEORY OF THE ATOM AND ITS FURTHER DEVELOPMENT. Jucys, A. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 3, 417-430(1974). (In Russian).

The ordinary method of nonrelativistic atomic theory based on the separable spin–orbit approximation is characterized. Means of improving the theory, multiconfiguration approximation, extended method, and incomplete separation of variables, are considered in brief. The mathematical methods used for carrying out the calculations with the angle and spin parts are considered. The advantage of the mathematical apparatus of Wigner–Racah over the methods using the determinantal wave function is pointed out. The necessity of using the same mathematical apparatus by groups of specialists in atomic theory is indicated. There are given examples hampering the development of the theory and coming from the difference of the mathematical methods used. The unsoundness of some terms often used in literature is indicated. (auth)

23940 RELATIVISTIC INVESTIGATION OF ELECTRON TRANSITIONS IN MANY-ELECTRON ATOMS. Kanyauskas, Yu. M.; Kychkin, I. S.; Rudzikas, Z. B. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 3, 463-475(1974). (In Russian).

Relativistic operators of electric and magnetic multipole transitions are expressed in terms of irreducible tensors and are transformed into the form convenient to find their matrix elements in the case of complex configurations. It is shown that these matrix elements are equivalent under various gauge conditions of the electromagnetic field. Matrix elements of the operators mentioned above are found for transitions between various kinds of electronic configurations. The coefficients of corresponding radial integrals except phase do not depend on the orbital quantum numbers. (auth)

23941 MANY-PARTICLE COULOMB INTERACTION. An Expansion in Terms of Hyperspherical Harmonics. Klar, H. (Univ., Freiburg i.B.). J. Phys., B (London); 7: No. 16, L436-L438(11 Nov 1974).

The nucleus-electron, as well as the electron-electron potentials, in all atomic systems are shown to have a simple expansion into hyperspherical harmonics. This expansion is useful for the calculation of matrix elements. (auth)

23942 ATOMIC AND MOLECULAR CALCULATIONS WITH THE MODEL POTENTIAL METHOD. III. Bonifacic, V.; Huzinaga, S. (Department of Chemistry, The University of Alberta, Edmonton, Alberta, Canada). J. Chem. Phys. 62: No. 4, 1509-1512 (15 Feb 1975).

Theoretical and computational possibilities of the model potential method are examined especially with respect to the feasibility of the semi–*ab initio* calculation of large molecular systems containing heavy atoms. The separate treatment of the valence and the core regions would enable us to handle more effectively the excitations of valence electrons and also to perform a relativistic calculation on the deep–seated core states. (auth)

23943 STUDY OF THE DISTINGUISHABLE ELECTRON METHOD. Chong, D.P.; Scott, W.R.; Yue, C.P. (Department of Chemistry, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5). J. Chem. Phys. 62: No. 4, 1540-1543 (15 Feb 1975).

Second–order corrections to first–order properties are calculated by the distinguishable electron method. The rate of convergence is contrary to what one expects from the zeroth– and first–order terms. The quality of the correlated wavefunctions used in DEM is therefore examined and found to be poor for the calculation of first–order properties. These results lead to a reassessment of the distinguishable electron method. (auth)

23944 THE SPLINE REPRESENTATION: II. SHELL ORBITALS AND EXPONENTIAL SPLINE BASES. Gilbert, T.L. (Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 62: No. 4, 1289-1298 (15 Feb 1975).

The cardinal spline expansion method for atomic calculations, introduced in a preceding article, is extended from linear to exponential

splines. These are obtained by replacing the spline basis functions $\chi_\nu(r)$ by $\chi_\nu(u)$, where $u = e^{-\zeta r}$. An orbital multiplying factor $r^{n-1}e^{-\zeta_{nl}r}$ is introduced for each shell in order to improve convergence. The Hartree–Fock equations for closed–shell atoms are transformed to equations for nodeless orbitals localized in atomic shells (shell orbitals), and the construction of shell orbitals for atoms embedded in molecules is discussed briefly. Explicit expressions for the one–center matrix elements are derived. A major advantage of the linear spline representation, viz., that the number of two–electron integrals increases only as the square of the basis size and the off–diagonal integrals can be factored, is retained. A comparison is made of the relative advantages and disadvantages of linear and exponential spline representations with regard to probable storage requirements, computing time, and program complexity. No numerical results are given, for the purpose of this work is to assess the optimum strategy for subsequent numerical studies. The linear spline representation, which can also be used for calculating shell orbitals, appears to be the most promising approach for further work. (auth)

23945 QUANTUM ELECTRODYNAMICS AND RADIATION REACTION: NONRELATIVISTIC ATOMIC FREQUENCY SHIFTS AND LIFETIMES. Ackerhalt, J.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Eberly, J.H. Phys. Rev. D 10: No. 10, 3350-3375 (15 Nov 1974).

We present a quantum electrodynamic treatment of radiative corrections in atoms which is patterned after Lorentz's classical work on radiation damping. Expressions for both radiative lifetimes and frequency shifts are calculated through second order in the electric charge for a fictitious two–level model atom and for a spinless one–electron atom with an infinite number of arbitrarily spaced energy levels. In order to apply the classical ideas of Lorentz to quantum–electrodynamic problems of this kind we work directly with the relevant dynamical variables of the atom and field. The calculations are carried out entirely in the Heisenberg picture by recognizing the importance of radiation reaction. The quantized–field operator equations are integrated with the aid of a Markov approximation. The part of the integrated field that arises from the atomic electron current operator, the radiation–reaction field, is shown to be solely responsible for the atom's linewidths and frequency shifts. It is clear that it is unnecessary to invoke vacuum fluctuations at any stage. The usual quantum electrodynamic exponential decay law is found to govern the expectation values of the energy and dipole moment of the atom as well as the radiated–field amplitude. The theory nevertheless remains unitary. The Heisenberg operator commutation relations are shown to be valid at all times, and the Markov approximation is justified for times longer than a reciprocal transition frequency. (auth)

23946 APPROXIMATE PROJECTED HARTREE–FOCK CALCULATIONS IN ATOMS, MOLECULES, AND THE ELECTRON GAS. Laskowski, B. Brussels; Univ. Brussels (1974). 121p. Centre d'Etude de l'Energie Nucleaire, Mol, Belgium.

Thesis.

The problem of correlations is a central one in many body physics. It is realized that correlations in the particle motion are to be included in the mathematical description of many body systems in order to reach an agreement with experimental data. An attempt is made to see what can be done if the independent particle model is pushed to its limits. By this we mean that one sticks to wave functions in which the particles are essentially assigned to definite orbitals. One allows the orbitals to take their optimal shape (unrestricted Hartree-Fock (UHF)) within some chosen model space. This picture is however, refined to account for fundamental symmetries (like the Pauli principle and angular momentum). This refinement is introduced with the help of projection operators; in technical language: Projected-UHF. The alternant molecular orbital (AMO) method is used as an approximate PHF case. Also some less known techniques like angular momentum projection and generator coordinate (GCM) formalism are introduced in their general form whereas the subsequent one uses only particular cases of these. A calculation concerning an example of each of the main fields is presented, i.e., atomic (Liatom) molecular and solid state physics respectively. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

23947 (AD-785235) ORTHOL: A 2D EXPLICIT GRID ORTHOGONALIZER FOR PSEUDO-LAGRANGIAN CODES. Anderson, D. V.; Clark, R. W. (Naval Research Lab., Washington, D. C. (USA)). Jul 1974. 27p. (NRL-MR-2849). NTIS $3.25.

A simple second order procedure is given for orthogonalizing a 2-D mesh which has been distorted by Lagrangian transport from an initially orthogonal configuration. One system of grid lines is customarily chosen to follow contours of a relevant physical quantity, while the second set of grid lines must be constructed orthogonal to the first set. This method has been found useful in the computation of MHD flows in self-consistent B-fields, and application to other fluid problems is obvious. As an example of the orthogonalizing procedure, the axisymmetric problem of an imposed azimuthal electric field driving a magnetic flux grid is considered. (auth)

23948 SOME EXACT SOLUTIONS OF A SYSTEM OF EQUATIONS OF ELECTROHYDRODYNAMICS. Buchin, V. A. J. Appl. Math. Mech. (USSR) (Engl. Transl.); 37: No. 1, 41-49(1973).

Translated from Prikl. Mat. Mekh.; 37: No. 1, 48-56(1973).

A class of exact solutions of a system of equations of electrohydrodynamics is studied for which the electric current is directed along streamlines of the hydrodynamic flow. In the two-dimensional case the solution is written down explicitly. It is shown how to construct other exact solutions for which the collinearity condition of the electric current density and velocity vectors has not been satisfied, by using the solutions obtained. As an illustration, an exact solution for the flow of an unipolarly charged fluid in a channel with electrode-walls is constructed. It is shown that for a particular kind of hydrodynamic eddy current the solution of the two-dimensional system of equations can be reduced in some cases to finding the solution of a system of ordinary differential equations. (Appl. Mech. Rev.)

23949 RELATIVISTIC MAGNETIC GAS DYNAMICS EQUATIONS IN THE CASE OF A LONGITUDINAL MAGNETIC FIELD. Gorskii, V. B. (Gorky State Univ., USSR). Dokl. Akad. Nauk SSSR; 215: No. 1, 64-67(1 Mar 1974). (In Russian).

Precise equations were obtained for the motion of the two-dimensional relativistic (in the framework of the special theory of relativity) steady adiabatic flow of a non-viscous ideally conducting gas in a longitudinal magnetic field. These equations were simplified for different cases where their idealization was possible and in very complex transition zones where the equations maintain a non-linear compound character. (JSR)

23950 MHD LAMINAR BOUNDARY LAYER ALONG A FLAT PLATE AND ITS STABILITY. Kobayashi, R. (Tohoku Univ., Sendai). Tohoku Daigaku Kosoku Rikigaku Kenkyusho Hokoku; 32: No. 315-323, 123-159(Sep 1973). (In Japanese).

Distribution of flow velocity, thickness of boundary layer, distribution of temperature and heat conductivity were investigated on the non-compressive laminar boundary layer of conductive fluid along a flat plate in the uniform magnetic field acting perpendicularly to the plate. Basic equations were an equation of motion, an equation of continuity, and an equation of energy on the non-compressive MHD laminar boundary layer, considering the conductive fluid with flow velocity V_∞ along a semi-infinite flat plate. The effect of secondary induced magnetic field was ignored. The distribution of velocity in velocity boundary layer and related quantity were calculated with sufficient accuracy for the investigation of stability. The distribution of temperature in the boundary layer was obtained with the consideration of friction heat and Joule's heat, and the variation of Nusselt number was made clear. The asymptotic distribution of temperature was seen when $Ec = -1/Pr$. The stability of the boundary layer to the minute disturbance of Tollmien-Schlichting wave form was studied. The critical Reynolds number increased with the increasing intensity of magnetic field. The critical Reynolds number depended on the special property of the velocity distribution. The condition of magnetic field to keep the boundary layer laminar on the whole region of the flat plate was determined. It is expected that total surface friction is reduced remarkably owing to the laminar boundary layer by the action of magnetic field. (JA)

23951 MAGNETOHYDRODYNAMIC OSCILLATORY FLOW NEAR A STAGNATION POINT. Mital, V. (Madhava Engineering Coll., Gwalior, India). J. Jiwaji Univ.; 1: No. 1, 52-70(Jan 1973).

Effects of plate oscillations on the two dimensional stagnation point flow of an incompressible viscous and electrically conducting fluid under a transverse magnetic field have been studied. It is found that for very high frequencies the flow pattern is a superposition of the steady flow and the oscillatory "shear wave" flow unaffected by magnetic field. For low frequencies, the oscillatory component of the skin friction lags behind the plate oscillations. The phase-lag decreases as the strength of the magnetic field increases. The transient case when the plate moves impulsively from rest has been deduced from the oscillatory flow case. (auth)

23952 MHD COUETTE FLOW WITH SUCTION AT THE STATIONARY PLATE. Soundalgekar, V. M. (Indian Inst. of Tech., Bombay). Mat. Vesn., Nova Ser.; 10: No. 2, 127-138 (1973).

An analysis of a two-dimensional MHD Couette flow of a viscous, incompressible and electrically conducting fluid between two parallel plates in relative motion and with suction at the stationary plate is carried out. The solution for the axial and the transverse components of the velocity is derived by the method of perturbation. It is observed that due to the development of an adverse pressure gradient, there is a reverse flow at small values of the axial distance. More conclusions are also presented during the course of discussion. (auth)

23953 HEAT TRANSFER IN MHD CHANNEL FLOW. Schroeder, P. Int. J. Heat Mass Transfer; 15: No. 12, 2667-2670(Dec 1972).

Solutions for temperature and velocity distributions in an incompressible magnetohydrodynamic (MHD) channel flow are presented in this short note. The steady, laminar, full-developed, incompressible flow of a non-Newtonian fluid is considered. Results obtained are functions of second-order hypergeometric functions using a power law viscosity relation and functions of incomplete elliptic integrals in the case of a Prandtl-Eyring viscosity equation. Expressions for temperature distributions in fully-developed flow are presented which can be evaluated from shear-stress distributions without solving the energy equation. (Appl. Mech. Rev.)

23954 HYDROMAGNETIC FALKNER-SKAN PROBLEM. Mital, V.; Badas, N. G. (Madhava Engineering Coll., Gwalior, India). J. Jiwaji Univ.; 1: No. 1, 71-79(Jan 1973).

The Falkner-Skan problem in magnetohydrodynamics when the magnetic field is perpendicular to the plate is analyzed. Similarity solution is obtained by the method of asymptotic functions. The viscous stress at the plate is found to increase with the increase in the magnetic parameter. A special case when the hydromagnetic pressure gradient is completely neutralized is also discussed. (auth)

23955 STABILITY OF HETEROGENEOUS FLOW UNDER UNIFORM INCLINED MAGNETIC FIELD. Pushpak, S. N.; Srivastava, K. M. (Univ. of Jodhpur, India). Istanbul Univ. Fen Fak. Mecm., Seri A; 36: 29-34(1971).

The stability of incompressible, heterogeneous nondissipative, nonviscous, vertically stratified and perfectly conducting fluid between two horizontal plates in the presence of a uniform magnetic field in the x-y plane is investigated. It is observed that: (i) For the stability in the direction of the magnetic field the critical force number reduces with the direction of the magnetic field, taking the critical magnetic force number along the streaming direction as a reference number. (ii) The system for the disturbance in the direction φ, is stable for the direction of the magnetic field θ, if $0 < (\theta/2) < \varphi < (\pi + \theta/2)$. (auth)

23956 BOUNDARY LAYER GROWTH OF AN INFINITE FLAT PLATE IN MAGNETOHYDRODYNAMICS. Mishra, S. P.; Mohapatra, P. (Utkal Univ., Bhubaneswar, India). Rev. Roum. Phys.; 19: No. 7, 687-704(1974).

The flow of an electrically conducting incompressible viscous liquid due to the time-varying motion of an infinite non-conducting plate has been studied in the presence of a magnetic field. The induced magnetic field produced by the motion has been taken into account. The effects of the magnetic field strength a_0 and "n" on the velocity field, magnetic field, electric field, current density and the shearing stress at the wall were studied by several graphs and a table. (auth)

23957 GEOMETRIES AND SOLUTIONS OF SOME STEADY MAGNETO FLUID DYNAMIC FLOWS. Nath, V. I. Windsor, Ont.; Univ. of Windsor (1973). 137p.

Thesis.

Steady MFD flows of fluids with infinite electrical conductivity are studied for the following cases: (a) inviscid, aligned

flows; (b) inviscid, transverse flows; and (c) incompressible, non-aligned flows. A substitution principle is developed for inviscid aligned and transverse flows when the equation of state of the fluid is of an arbitrary form. Geometries of the flows, for which the substitution principle holds, are obtained. For incompressible, inviscid aligned, transverse and orthogonal flows, the conditions for two dynamically distinct flows to have the same streamline pattern are determined. For inviscid aligned flows geometries of plane, axially symmetric, spatial irrotational and spatial doubly-laminar flows, when velocity magnitude is constant along each streamline, are obtained. For inviscid transverse flows a linear hyperbolic partial differential equation of second order in speed is obtained by eliminating other flow variables from the flow equations in natural co-ordinates. The speed equation is solved for flow through a logarithmic channel. For inviscid orthogonal flows, geometries of the flows are obtained when either the local speed of sound, or the pressure or the density or the speed of the fluid is constant along each streamline. The conditions under which the pressure is constant along orthogonal trajectories in an isometric net are found. The geometries of straight streamlines for fluids having product equation of state, are studied. Finally, for plane, incompressible, non-aligned flows, a new form of the fundamental equations is obtained. (CA)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 24002 and 24003.

23958 BATMAN: AN AUTOMATIC BATCH PROCESSING SYSTEM. Clayton, J.; Matthews, R.; West, N. (Liverpool Univ. (UK)). Comput. Phys. Commun.; 8: No. 3, 143-148(Oct 1974).

A system is described which combines the facilities of automatic batch processing, tape management and bookkeeping. Although it was developed for use with high energy physics experiments it could be adapted for more general use and therefore programming details excluded. (auth)

Electromagnetic

Refer also to abstract 22790.

23959 (DESY-74/62) MEASUREMENT OF COLLINEAR AND NEARLY COLLINEAR PHOTON PAIRS PRODUCED BY e^+e^- ANNIHILATION AT THE 3100 MeV RESONANCE. Braunschweig, W.; Jordan, C. L.; Martyn, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Dec 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

Collinear and nearly collinear photon pairs from e^+e^- annihilation were measured at total energies covering the resonance at 3100 MeV. The observed cross section is in good agreement with the $e^+e^- \rightarrow \gamma\gamma$ cross section expected from quantum electrodynamics. Upper limits for the decay modes $(3100) \rightarrow \gamma\gamma$, $\pi^0\gamma$ and other modes are derived. (auth)

23960 SEARCH FOR PHOTOPRODUCTION OF ψ (3105). Andrews, D.E.; Harvey, J.; Lobkowicz, F.; May, E.N.; Nelson, C.A. Jr.; Thorndike, E.H. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627); Nordberg, M.E. Jr. Phys. Rev. Lett. 34: No. 4, 231-233 (27 Jan 1975).

The product of the photoproduction cross section at 11.1 GeV for ψ (3105) on nucleons times the branching ratio for ψ into e^+e^- is less than 75 pb, at the 90% confidence level. This result implies a ψ–nucleon total cross section of less than 1.2 mb. (auth)

23961 EXPERIMENTAL UPPER LIMIT ON THE PHOTOPRODUCTION CROSS SECTION FOR THE ψ (3105). Martin, J.F.; Bolon, C.; Lanza, R.L.; Luckey, D.; Osborne, L.S.; Roth, D.G. (Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139); Dakin, J.T.; Feldman, G.J.; Hanson, G.; Lyon, D.E.; Perl, M.L.; Pun, T. Phys. Rev. Lett. 34: No. 5, 288-290 (3 Feb 1975).

The experimental upper limit for the diffractive photoproduction of the ψ (3105) is 29 nb, with 90% confidence, at an average photon energy of 18.2 GeV. (auth)

Weak

Refer also to abstracts 24180 and 24189.

23962 (CONF-730580-, pp 1-14) NEUTRAL KAON REGENERATION ON CARBON IN THE MOMENTUM REGION OF 16 TO 40 GEV/c. Birulev, V. K.; Deak, F.; Genchev, V. (Dubna-Serpukhov-Budapest-Prague-Berlin-Sofia Collaboration). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

Preliminary results of an experiment designed to measure parameters for K^0 regeneration behind a 1 meter carbon regenerator are reported. (JFP)

23963 EARLY TESTS OF SCALE INVARIANCE IN HIGH-ENERGY MUON SCATTERING. Fox, D. J. (Michigan State Univ., East Lansing); Chang, C.; Chen, K. W.; Kotlewski, A.; Kunz, P. F.; Hand, L. N.; Herb, S.; Loken, S. C.; Russell, A.; Watanabe, Y.; Vernon, W.; Strovink, M. Phys. Rev. Lett.; 33: No. 25, 1504-1507(16 Dec 1974).

Data are presented on deep inelastic scattering of 56.3- and 150-GeV μ^+ from an iron target at the Fermi National Accelerator Laboratory. Observed event rates, averaged over a wide range in ω, are compared to scale invariance predictions for q^2 up to 44 $(GeV/c)^2$. The ratio of the 150-GeV data to the scale-invariance prediction versus q^2 is not constant for all accepted ω values. A fit of the form $(1 + q^2/\Lambda^2)^{-2}$ yields a lower limit of $\Lambda > 10$ GeV with 90% confidence, averaged over a restricted ω range. (auth)

23964 EXPERIMENTAL MEASUREMENT OF THE FORM FACTORS OF THE DECAY $K_L^0 \rightarrow \pi^+e^-\nu$. Blumenthal, R.; Frankel, S.; Nagy, J.; Resvanis, L.; Van Dyck, O.; Werbeck, R.; Winston, R.; Highland, V. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. Lett.; 34: No. 3, 164-168(20 Jan 1975).

We have analyzed 25000 K_{e3} decays, reconstructed to the center of mass by measurement of the K_L^0 momentum from time of flight and measurement of the π and e momenta with a spark-chamber-magnet spectrometer. Using the linear parametrization of the vector form factor $f_+(q^2) = 1 + \lambda_+(q^2/m_\pi^2)$, we find $\lambda_+ = 0.0270 \pm 0.0028$. Upper limits for the scalar (f_s) and tensor (f_t) form factors at the 68% confidence level are $f_s/f_+ < 0.04$, $f_t/f_+ < 0.23$, corresponding to intensity ratios $I_s/I_v < 0.3\%$ and $I_t/I_v < 0.4\%$. (auth)

23965 MEASUREMENT OF $e^+e^- \rightarrow e^+e^-$ AND $e^+e^- \rightarrow \mu^+\mu^-$. Augustin, J. E.; Boyarski, A. M.; Breidenbach, M.; Bulos, F.; Dakin, J. T.; Feldman, G. J.; Fischer, G. E.; Fryberger, D.; Hanson, G.; Jean-Marie, B.; Larsen, R. R.; Luth, V.; Lynch, H. L.; Lyon, D.; Morehouse, C. C.; Paterson, J. M.; Perl, M. L.; Richter, B.; Schwitters, R. F.; Vannucci, F.; Abrams, G. S.; Briggs, D.; Chinowsky, W.; Friedberg, C. E.; Goldhaber, G.; Hollebeek, R. J.; Kadyk, J. A.; Trilling, G. H.; Whitaker, J. S.; Zipse, J. E. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett.; 34: No. 4, 233-236(27 Jan 1975).

The reactions $e^+e^- \rightarrow e^+e^-$ and $e^+e^- \rightarrow \mu^+\mu^-$ were measured at center-of-mass energies 3.0, 3.8, and 4.8 GeV and production angles of $50 < \theta < 130°$ over all azimuthal angles. Agreement with quantum electrodynamics is excellent. New limits for cut-off parameters in quantum-electrodynamic-breakdown models are given. (auth)

Strong (Baryon-induced)

Refer also to abstract 24206.

23966 (CONF-730580-) PROCEEDINGS OF THE TRIANGLE SEMINAR, TRIESTE, ITALY, May 28–29, 1973. Fidecaro, G. (ed.). (Istituto Nazionale di Fisica Nucleare, Trieste (Italy)). 15 Oct 1973. 257p.

The conference included 16 papers, two of which were abstracted previously in NSA as: 29: 17005 and 29: 11224. Separate abstracts were prepared for 14 papers. (JFP)

For abstracts of individual papers see: 22785–22787, 23962, 23967–23970, 23977–23980, 24070, and 24353.

23967 (CONF-730580-, pp 15-19) SECONDARY PARTICLE MULTIPLICITIES IN pp COLLISIONS AT THE ISR. Gottfried, C. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The predicted limiting behavior is observed in the scaled multiplicity distributions for all energies for charged particles produced in the reactions $p + p \rightarrow n_{charged}$ + anything at 23 to 53 GeV. (JFP)

23968 (CONF-730580-, pp 20-27) BACKGROUND PROBLEMS IN THE REACTION $pp \rightarrow p(n\pi^+)$ AT THE ISR. Dibon, H. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

A report is given on background rejection possibilities for the reactions $pp \rightarrow p(n\pi^+\pi^0)$ and $pp \rightarrow (p\pi^0)(n\pi^+)$. It is concluded that by reasonable combination of anticounters and kinematical fit, one can reduce the background to an acceptable amount. (JFP)

23969 (CONF-730580-, pp 29-32) SPIN AND ISOSPIN EFFECTS IN PROTON–NUCLEON SCATTERING AT ENERGIES BETWEEN 25 AND 150 GeV/c. Steuer, M. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The physical interest and experimental possibilities of the measurement of the polarization parameter in the reactions $pp \rightarrow pp$, $pn \rightarrow pn$, and $pn \rightarrow np$ are studied for the energy range between 25

and 150 GeV and a momentum transfer up to 3 $(GeV/c)^2$. The elastic scattering amplitudes, angular distributions, polarization parameter, and cross sections are discussed. (JFP)

23970 (CONF-730580-, pp 69-84) Λ-PRODUCTION IN K^-p REACTIONS. Girtler, P. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

Results are presented on Λ production in exclusive multiparticle final states at 8.25 and 10.1 GeV/c. The Y^* production in the various channels is investigated. It is shown that there exists some difference between Y^{*+} and Y^{*-} production dependent on the reaction under consideration. Momentum and mass distributions are discussed. (JFP)

23971 (COO-1428-395) PERIPHERAL NUCLEON–ANTINUCLEON PRODUCTION BY 13 GeV/c PIONS. Dulude, R. S.; Gaidos, J. A. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics). [nd]. 21p. Dep. NTIS $4.25.

Thesis.

A measurement of the cross sections for $\pi^+p \to (p\bar{n})p$ and $\pi^-p \to (\bar{p}n)p$ within the range $-t(pp) < 0.5$ $(GeV/c)^2$ corresponding to identifiable recoil protons and with mass $m(N\bar{N}) < 2.7$ GeV for unambiguous one-constraint fits yields values of 25.9 ± 1.6 μb at 13.1 GeV/c and 29.1 ± 2.4 μb at 13.2 GeV/c, respectively. The angular distributions of $N\bar{N}$ vary strongly with $m(N\bar{N})$ and suggest high spins. The cross section for $\pi^+p \to (p\bar{p})\Delta^{++}$ with t' $(p\Delta) < 0.75$ $(GeV/c)^2$ is 3.7 ± 0.4 μb and may be mediated by M1 ρ-exchange. (auth)

23972 (JINR-1-7739) MOMENTUM SPECTRUM OF K^0-MESONS PRODUCED BY THE 70 GeV PROTONS ON ALUMINUM NUCLEI. Vestergombi, D.; Voverko, A. S.; Genchev, V.; Kekelidze, V. D.; Krivokhizhin, V. C.; Kukhtin, V. V.; Likhachev, M. F.; Nad, E.; Fyzek, Kh. E.; Savin, I. A.; Silvestrov, L. V.; Takhtamyshev, G. G.; Todorov, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 12p. (In Russian). INIS.

A pulse spectrum is obtained of K^0-mesons generated at an angle of 1° on an aluminum target of the accelerator of Serpukhov. The form of the spectrum is approximated by two functions, one of which depended only on the transverse momentum of the kaons, while the second depended on the transverse momentum and a scaling variable X. The experimental data are in agreement with both theoretical functions. The form of the spectrum of the kaons is compared at energies of 19.2, 24 and 70 GeV. It was established that the spectral form practically does not depend on the energy of the primary protons within the indicated limits. (tr-SJR)

23973 (JINR-E1-8334) SEARCH FOR A ΔΔ(1236) COMPONENT IN THE DEUTERON. Aladashvili, B. S.; Badelek, B.; Glagolev, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 17p. Dep. NTIS (US Sales Only). $4.00.

The $dp \to nnp\pi^+$, $dp \to ppn\pi^0$, and $dp \to ppp\pi^-$ reactions at a 3.33 GeV/c deuteron momentum on a proton target were studied in order to search for a ΔΔ configuration in the deuteron. Frequent backward emission of the $(p\pi^+)$, $(n\pi^0)$, and $(p\pi^-)$ systems in the deuteron rest frame was observed. The origin of the effect is analyzed from the viewpoint of the possible ΔΔ admixture in the deuteron wave function. Some other sources which may contribute to the signal are pointed out. (8 figures, 1 table) (auth)

23974 NEUPRUGIE SOUDARENIYA CHASTITS BOL'SHOI ENERGII S NUKLONAMI I YADRAMI. (Inelastic Collisions of High-Energy Particles with Nucleons and Nuclei). Azimov, S. A.; Yuldashbaev, T. S. Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). 111p.

The results of studies on the inelastic interaction of cosmic hadrons at 200 to 2000 GeV with nuclei are given. Special attention is given to methodic questions connected with the measurement of the energy of primary and secondary particles, techniques of wide-gap spark chambers, and Cherenkov detectors. The interaction characteristics, such as multiplicity of newly created particles, their angular distribution, and coefficient of inelasticity, are examined. (tr-auth)

23975 OBSERVATION OF INCREASING CHARGED MULTIPLICITY AS A FUNCTION OF TRANSVERSE MOMENTUM IN $p+p \to \pi^+ + MM$ AT 28.5 GeV/c. Anderson, E.W.; Clifford, T.S.; Fisher, G.P.; Larson, G.P.; Lazarus, E.; Moy, K.M.; Turkot, F.; Schübelin, P.; Schreiner, W.N.; von Lindern, L. (Brookhaven National Laboratory, Upton, New York 11973); Gutay, L.J.; Lassanen, A.; Collins, G.B.; Ficenec, J.R.; Gilbert, D.R.; Stringfellow, B.C.; Trower, W.P. Phys. Rev. Lett. 34: No. 5, 294-296 (3 Feb 1975).

We have measured the mean charged multiplicity $\bar{n}_c$ as a function of the transverse momentum $p_\perp$ of a forward π^+ meson for fixed missing mass MM in the reaction $p+p \to \pi^+ + MM$ using the multiparticle Argo spectrometer system. We observe an increase similar to that seen in $p+p \to p+MM$ at the same incident energy. (auth)

23976 MEASUREMENT OF THE n-d COHERENT SCATTERING AMPLITUDE USING THE NEUTRON GRAVITY REFRACTOMETER AT THE RESEARCH REACTOR OF THE TECHNICAL UNIVERSITY OF MUNICH. Nistler, W. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Naturforsch., 29A: No. 9, 1284-1290(Sep 1974). (In German).

Measurements of the coherent scattering amplitudes of various mixtures of heavy and light water are reported. By means of mirror reflection technique the coherent scattering amplitudes of the D_2O and H_2O molecule are determined to be 19.148 ± 0.004 F and -1.679 ± 0.004 F, respectively. Use of $a_H = -3.740 \pm 0.003$ F, obtained by the same technique, yields $a_D = 6.674 \pm 0.006$ F as the bound scattering amplitude of the deuterium nucleus. This value disagrees with the widely accepted 6.21 ± 0.04 F, reported by Bartolini et al. in 1968. (auth)

Strong (Meson-induced)

23977 (CONF-730580-, pp 47-55) ANOMALOUS Q-BUMP IN THE REACTION $K^-p \to K^-p\pi^+\pi^-\pi^0$. Lambacher, H. D. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

Some preliminary features and results concerning the Q region in the reaction $K^-p \to K^-p\pi^+\pi^-\pi^0$ (4B channel) at 8.25 to 16 GeV/c are presented, and the appearance of the so-called anomalous Q bump is discussed. It is concluded that the chance of this bump being a resonance is very small and that it is probably only a kinematical enhancement. (JFP)

23978 (CONF-730580-, pp 85-125) BOSON RESONANCES WITH MASS CLOSE TO THE TWO NUCLEON MASS: THE S REGION. 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

A review is given of production and formation experiments for boson resonances with mass close to the two-nucleon mass, the S region. Only confirmed experimental results are emphasized. (JFP)

23979 (CONF-730580-, pp 155-171) STATUS REPORT ON THE EXPERIMENT $\pi^-p \to p\pi^-$ AND $\pi^-p \to \Sigma^-K^+$ ON A POLARIZED PROTON TARGET TO STUDY BACKWARD SCATTERING AT 3.5 GeV/c. 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The description of the experimental program to study the reactions $\pi^- + p \to \Sigma^- + K^+$ and $\pi^- + p \to p + \pi^-$ emphasizes the modifications which were introduced. (JFP)

23980 (CONF-730580, pp 215-230) POLARIZATION MEASUREMENTS IN PION–NUCLEON BACKWARD SCATTERING. 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The discussion of polarization measurements in pion–nucleon backward scattering includes the quantities to be measured, the information obtained from these reactions, and the remaining problems. (JFP)

23981 (ITEF-73) INCLUSIVE CROSS SECTION OF THE $\pi^+p \to \pi^+ +$ ANYTHING IN THE INCIDENT PARTICLE FRAGMENTATION REGION AT 2.69 GeV/c. Abramov, B. M.; Vladimirskii, V. V.; Dukhovskoi, I. A.; Kushkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Radkevich, I. A.; Fedorets, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. (In Russian). INIS.

The inclusive cross-section is measured for the reaction $\pi^- + p \to \pi^+ +$ anything in the region of fragmentation of the incident particle at a momentum of 2.69 GeV/c. A comparison with data at higher energies is carried out. Approach of an invariant cross-section to an asymptotic mode is discussed. (tr-SJR)

23982 (JINR-1-7427) REGENERATION OF $K_1^0 - K_2^0$ ON THE DEUTERIUM. Al'brekht, K. F.; Birulev, V. K.; Deak, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). INIS.

The modulus and phase of the amplitude of regeneration of neutral kaons on deuterium are measured in the region of momenta of 18 to 50 GeV/c. The modulus of the amplitude of regeneration decreases with an increase in momentum of kaons, and the phase does not depend on the energy, and within the limits of error, agrees with the value predicted by the model of complex angular momenta for the case of an exchange of the omega-pole. (tr-SJR)

23983 A STUDY OF THE REACTION $K^-p \to K^-\omega p$ AT 8.25 GeV/c. Theocharopoulos, P.; Apostolakis, A.; Michaelidis, P.; Sakellion, L.; Stergiou, A. (Athens Univ. (Greece)); Filippas, T. A.; Grammatikakis, G.; Simopolou, E.; Tsilimigras, P.; Vayaki, A. (Democritus Nuclear Research Center, Athens (Greece)). Nucl. Phys., B; 83: No. 1, 1-24(11 Dec 1974).

The final state $K^-\omega p$ shows no significant resonance production at 8.25 GeV/c. A double moments analysis of the broad threshold ($K^-\omega$) enhancement shows the presence of 0^-, 1^+ and 1^- spin-parity states. The last one was found to contribute about 10% (while the contributions from 1^+ and 0^- could not be separated). An analysis of the final state in terms of the CLA model shows a qualitative agreement with the data. Moreover, using the same parameters, the predicted distributions at 6 and 10 GeV/c show the same qualitative agreement with the published data. (auth)

23984 THE CHARACTERISTICS OF K^{*0} AND $\overline{K}^{*0}$ PRODUCTION $K^0_L p$ INTERACTIONS BELOW 3 GeV/c. Stumer, I.; Alexander, G.; Benary, O.; Dagan, S.; Grunhaus, J.; Lissauer, D.; Oren, Y. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Putzer, A.; Bar-Nir, I.; Burkhardt, E. (Heidelberg Univ. (F.R. Germany). Inst. fuer Hochenergiephysik). Nucl. Phys., B; 83: No. 1, 45-59(11 Dec 1974).

The production features of $K^0p \to K^{*0}p$ and $\overline{K}^0p \to \overline{K}^{*0}p$ were investigated in a $K^0_L p$ experiment using a continuous incident momentum from 0.8 to 3 GeV/c. Both $K^*(890)$ and $\overline{K}^*(890)$ are peripherally produced and are well described by vector and pseudoscalar exchange in the t-channel. The partial contributions of the I = 0,1 amplitudes and their interference terms to the total $KN \to K^*N$ ($\overline{K}N \to \overline{K}^*N$) cross sections were determined up to 5 GeV/c using the present data as well as other experimental results. This separation was done in both the s- and t-channels. The ratio $\sigma(KN \to K^*N)/\sigma(\overline{K}N \to \overline{K}^*N)$ is discussed using the separated t-channel isospin amplitudes. (auth)

23985 COHERENT PION PRODUCTION FROM DEUTERIUM BY 7 GeV/c POSITIVE PIONS. Harrison, D. M. Toronto; Univ. of Toronto (1972). 78p.

Thesis.

Coherent production of 3π and 4π off deuterium was measured in a 650,000 picture exposure of the 30'' MURA-ANL deuterium-filled bubble chamber to 6.95 GeV/c π^+. The total cross section for the reaction $\pi^+d \to \pi^+\pi^+\pi^-d$ was measured to be 430 ± 40 μb, and this final state was found to be dominated by ρ^0 production. In addition, A_1^+ and d^{*++} production is observed, evidence for A_2^+ production is presented, and the existence of $\rho^0\omega$ interference in this final state is demonstrated. The cross section for the reaction $\pi^+d \to \pi^+\pi^+\pi^0\pi^-d$ was measured to be 65 ± 8 μb, and ω, d^{*++} and some ρ production is observed. (auth)

23986 EVIDENCE FOR ρ^0 PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Gordon, H.A.; Habibi, M.M.; Lai, K. W.; Stumer, I. (Brookhaven National Laboratory , Upton, New York 11973). (Phys. Rev. Lett. 34: No. 5, 284-287(3 Feb 1975).

We have extracted the ρ^0 inclusive cross section from π^+p interactions at 6 and 22 GeV/c as a function of the longitudinal variables y^* and x, and the transverse momentum P_T. The ratio of ρ^0 to π inclusive cross sections is found to be rising linearly with P_T^2, and at $P_T \simeq 1$ GeV/c the ρ^0 and π^- inclusive cross sections are equal. The implications of this observation for direct lepton production are discussed. (auth)

23987 DISCOVERY OF A SECOND NARROW RESONANCE IN e^+e^--ANNIHILATION. Abrams, G. S. (Univ. of California, Berkeley); Briggs, D.; Chinowsky, W.; Friedberg, C. E.; Goldhaber, G.; Hollebeek, R. J.; Kadyk, J. A.; Litke, A.; Lulu, B.; Pierre, F.; Sadoulet, B.; Trilling, G. H.; Whitaker, J. S.; Wiss, J.; Zipse, J. E.; Augustin, J. E.; Boyarski, A. M.; Breidenbach, M.; Bulos, F.; Feldman, G. J.; Fischer, G. E.; Fryberger, D.; Hanson, G.; Jean-Marie, B.; Larsen, R. R.; Luth, V.; Lynch, H. L.; Lyon, D.; Morehouse, C. C.; Paterson, J. M.; Perl, M. L.; Richter, B.; Rapidis, P.; Schwitters, R. F.; Tanenbaum, W.; Vannucci, F. Phys. Rev. Lett.; 33: No. 24, 1453-1455(9 Dec 1974).

A second sharp peak was observed in the cross section for $e^+e^- \to$ hadrons at a center-of-mass energy of 3.695 ± 0.004 GeV. The upper limit of the full width at half-maximum is 2.7 MeV. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 24563 and 24564.

23988 (CONF-730660-P1, pp A32-A44) EXTERNAL (KINEMATICAL) AND INTERNAL (DYNAMICAL) CONFORMAL SYMMETRY AND DISCRETE MASS SPECTRUM. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

A framework is presented in which both the space-time conformed transformations and the dynamical conformal transformations on internal coordinates of the relativistic two-body problem occur. The mass spectrum is discussed. (auth)

23989 (N-74-28158) FLUX QUANTIZATION AND FRACTIONAL CHARGES OF QUARKS. Jehle, H. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1974. 33p. (TR-74-095; MPI-PAE/PTH-14). NTIS $4.75.

Superposition of a continuous manifold of loopforms, or the alternative forms which one quantized magnetic flux loop might adopt are considered for an electron as well as a quark. An analysis of the types of flux loops and of their modes of spinning and whirling were studied to find the relation between the loop of an integer-charge lepton and the loop of a fractional-charge quark. It is shown that a consistent model exists which substantiates the claim that these elementary loops are the basic units of particle physics. Simple topological properties of various types of loops, and of linked pairs and triplets of loops, are shown to characterize leptons, mesons, and baryons. It is concluded that the difference between electromagnetic, strong, and weak interactions is essentially one of the topology of interaction of flux loops. (auth)

23990 (RL-74-155) SPIN OF LEADING CLUSTERS AND SLOPE OF THE OVERLAP FUNCTION. Bialas, A.; Sakai, N. (Science Research Council, Chilton (UK). Rutherford Lab.). Dec 1974. 7p. Dep. NTIS (US Sales Only) $4.00.

It is pointed out that the spin structure of leading clusters appearing in the final state of inelastic collisions at high energies influences strongly the estimate of the slope of the overlap function. It is also argued that this effect may drastically improve the agreement with experimental data. (auth)

23991 (RLO-2041-114) ASPECTS OF EXCHANGE PROCESSES. Lam, K. C. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Aug 1974. 79p. Dep. NTIS $7.00.

Thesis.

The spin structure theorem is proven for single-particle exchange interactions. Also calculations are performed with the spin effects separated out as much as possible to test vigorously the idea that the strong cut-off in total angular momentum space contains spin effects. The results are compared with experimental results for $\pi^- + p \to \pi^0 + n$ interactions. (JFP)

23992 ANALYTICAL EXPRESSIONS FOR MULTIPLICITY DISTRIBUTIONS AND DEVIATIONS FROM KNO SCALING. Auerbach, S. P. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 83: No. 3, 453-460(25 Dec 1974).

A simple method is presented for deducing multiplicity distributions from a few multiplicity moments. The essence of the method is the straightforward trick of converting a discrete distribution to a continuous distribution by interpolation. Interpolation changes the moments by calculable amounts, which depend only on the interpolation procedure and not on the multiplicity distribution. This device makes it possible to give a simple analytical expression for the multiplicity distribution, even at rather low energies, in terms of the measured moments. A quantitative discussion of KNO scaling, and deviations from scaling, is given, based on the measured moments. (auth)

23993 LORENTZ PROPERTIES OF THE THREE-STRING VERTEX. Mandelstam, S. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 83: No. 3, 413-439(25 Dec 1974).

The three-string vertex is shown to be Lorentz invariant by virtue of the locality properties of the Lorentz generator. The operators cannot be normal ordered and a high frequency cutoff must be introduced. Anomalous terms thereby appear at the joining point, but they cancel at the critical dimension of space-time. The off-shell vertex changes under a Lorentz transforma-

tion as a result of the change of the interaction time, but S-matrix elements are Lorentz invariant. The Neveu–Schwarz–Ramond (NSR) model is also treated; the form of the Lorentz generator may be understood by referring to the antiferromagnetic string model of Aharonov, Casher and Susskind. In both the orbital model and the NSR model the Lorentz-transformation properties of the vertex guarantee that the volume element of the dual-model integration is conformally invariant. This last result is extended to loops. (auth)

23994 SEMI-INCLUSIVE TWO-PARTICLE RAPIDITY CORRELATIONS AT ISR ENERGIES AND INDEPENDENT CLUSTER EMISSION MODEL. Ranft, G. (European Organization for Nuclear Research, Geneva (Switzerland)); Ranft, J. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). Nucl. Phys., B; 83: No. 2, 285-310(18 Dec 1974).

Semi-inclusive rapidity correlations at NAL and ISR energies are studied within a cluster model. For the nondiffractive component central mesonic clusters are produced independently and they decay isotropically; their exclusive decay law is assumed to follow a Boltzmann spectrum with a temperature parameter depending on the ratio of cluster mass to decay multiplicity; this temperature parameter is not bounded by a maximal temperature. This distribution is approximately equivalent to a Gaussian in rapidity. At $y_1 = y_2 = 0$ the diffractive component is found to be small. The general structure of the semi-inclusive correlation function agrees well with data from NAL and ISR. The div ded semi-inclusive correlation function for rapidities $y_1 = y_2 = 0$ for +− and −− channels is compared in detail with NAL data as a function of n_{ch}. The same type of central clusters which were found to explain inclusive correlations describe consistently also semi-inclusive reactions. The central clusters have an average mass ⟨M⟩ ~ 2 GeV independent of collision energy and they decay isotropically into about 2.5 charged particles. (auth)

23995 MULTIPERIPHERAL OPERATOR FACTORIZATION AND THE BOOTSTRAP IDEA. Bassetto, A.; Bonora, L.; Pasti, P. (Padua Univ. (Italy). Istituto di Fisica). Nucl. Phys., B; 83: No. 2, 333-361(18 Dec 1974).

Multiparticle production models are discussed including important direct channel unitarity effects in the light of the general multiperipheral dynamics proposed by Bassetto, Sertorio and Toller. First the Finkelstein–Zachariasen model is solved by means of the explicit t-channel operator factorization of the exclusive production amplitudes. It is shown that the absorption, which is introduced in the model according to the Gottfried–Jackson recipe, can be decomposed locally into factors along the multiperipheral chain. Then a simple model is proposed which possesses diffractive contributions in the inelastic channels still exhibiting total cross section and multiplicity fluctuations with the same asymptotic behavior as the ones of the Finkelstein–Zachariasen model. It is solved again by means of t-channel factorization. Comments are made on the relation between exclusive and inclusive factorization, and it is shown that the scheme could lead to a wider realization of the bootstrap model. (auth)

23996 BOUND STATE MODELS FOR FERMION REGGE POLES. Roig, F. S.; Swift, A. R. (Massachusetts Univ., Amherst (USA)). Nucl. Phys., B; 82: No. 3, 499-509(4 Dec 1974).

Trajectories of fermion Regge poles are calculated in a model in which a spin ½ particle is bound to a spin 0 core. The leading trajectory with parity $(-1)^{J-\frac{1}{2}}$ is much like the boson trajectory generated by similar interactions. The opposite parity trajectory satisfies the constraints of MacDowell symmetry, yet is totally distinct for $s > 0$. The model produces a trajectory which above the elastic threshold has a small negative Im α and an increasing Re α. Such a trajectory produces poles on the physical sheet of the energy plane. (auth)

23997 MULTIPERIPHERAL MODELS WITH LONG RANGE CORRELATIONS. Steinhoff, J. (McGill Univ., Montreal, Quebec (Canada). Dept. of Physics). Nucl. Phys., B; 82: No. 3, 461-476 (4 Dec 1974).

Particle production is discussed in a class of multiperipheral models. The feature common to all of the models is a boundedness of the K-particle inclusive distributions, as $s \to \infty$. It is found that in some of the models long-range correlations can occur, but only as a critical coupling phenomenon, at a certain value of the coupling constant. For stronger couplings a gas-like distribution results with short correlations, while for weaker couplings only a fixed number of particles are produced, which condense against the "walls" or ends of phase space. The two cases resemble respectively the "multiperipheral" and "diffractive" components of usual two-component theories, and many of the combined features can be incorporated in the unified model at the critical coupling. There are radical differences between the usual "multicomponent" theory and the present one, however, which are discussed. (auth)

23998 SEARCH FOR EXPERIMENTAL EVIDENCE ON EXCLUSIVE DOUBLE-POMERON EXCHANGE. Chew, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 82: No. 3, 422-446(4 Dec 1974).

Experience with single diffraction is used to motivate a proposed definition for the phase-space region of exclusive double-pomeron exchange (DPE); the definition involves two ratios of missing-mass to total energy. The kinematical implications of the proposed definition are explored through a triangle plot in Z variables—the logarithms of these ratios—and the problem of background is analyzed through a double-Regge expansion. It is shown that forthcoming NAL experiments should have no difficulty in establishing the presence or absence of exclusive double pomeron exchange. The results of previous attempts to measure DPE are reconsidered in terms of the Z variables, and it is found that the statistics accumulated to date are inadequate. Recent 205 GeV/c NAL experiments on $\pi^- p \to p\pi^-\pi^+\pi^-$ and $pp \to pp\pi^+\pi^-$ are discussed in some detail. (auth)

23999 GAUGE INVARIANCE AND CORRECTIONS TO DEEP INELASTIC SCALING. Jackson, C. P. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Nucl. Phys., B; 83: No. 1, 32-44(11 Dec 1974).

The asymptotic behavior of the correction terms to scaling for the deep inelastic structure functions is analyzed in the covariant parton model. It is shown by consideration of the $\omega \to 1$ limit that the noncanonical secondary terms from the "hand-bag" diagram cannot be made gauge invariant. The large ω behavior of the terms is also considered, and it is concluded that scale breaking effects are likely to be significant at large values of ω. (auth)

24000 LIGHT CONE ALGEBRA IN VARIOUS QUARK MODELS. Murtaza, G. (Univ. of Islamabad, Pakistan). Fortschr. Phys.; 22: No. 1-2, 53-110(1974).

In order to construct the light cone algebra, one uses the field theoretic quark model (possibly with vector gluons) as a guide and abstracts the commutation relations in the vicinity of the light cone. Finally one hopes that the same will also hold in the real interacting world. The algebraic framework thus obtained verifies the scaling hypothesis, and in addition makes a number of predictions for the scale functions of the inelastic electron and neutrino scattering. Deep inelastic electron–nucleon scattering, deep inelastic neutrino–nucleon scattering, electron–positron annihilation and quark models, and the light cone approach in a unified theory of weak and electromagnetic interactions are treated. (JFP)

24001 DUALITY AND MULTIPARTICLE PRODUCTION. Gordon, E. M. Montreal; McGill Univ. (1973). 122p.

Thesis.

Some properties and applications of two models for multiparticle production are studied. The first is the dual resonance model. The operator formalism in this model is extended to the case of Regge trajectories with unequal intercepts in all channels. Factorization of the amplitude is imposed with the result that a specific parameterization of the Regge trajectories is obtained and a quark picture of the dual model emerges. The questions of ghost compensation and SU(1,1) symmetry of the amplitude in the unequal intercept case are examined. The second model considered is the diffractive excitation model. The factors that determine the shapes of the inclusive single particle spectra in this model are examined in detail, with emphasis on correlations between the longitudinal and transverse momenta of the produced particles. Calculations are presented for a wide variety of reactions and the results are found to compare well with experiment, particularly since no free parameters are used. (auth)

24002 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 24, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 83p.

24003 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 25, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 98p.

24004 TRACE TECHNIQUES FOR ANGULAR MOMENTUM OPERATORS. Subramanian, P. R.; Devanathan, V. (Univ. of Madras). J. Phys., A (London); 7: No. 16, 1995-2007(1 Nov 1974).

General expressions for traces of products of angular momentum matrices (both in Cartesian and spherical bases) for systems of arbitrary spin are derived using the well established properties. It is shown that the trace is a polynomial in η where η is the eigenvalue of the J^2 operator. The trace techniques developed are applied to the problems of spin orientation. (auth)

24005 POSSIBLE EXISTENCE OF NEW MEDIUM INTERACTIONS AND 3.1− AND 3.7−GeV PARTICLES. Kim, C.W.; Sato, A. (Department of Physics, The Johns Hopkins University,

Baltimore, Maryland 21218). Phys. Rev. Lett. 34: No. 6, 361-365 (10 Feb 1975).

We propose a new fundamental interaction of an "effective" strength which is comparable with that of the electromagnetic interaction. This interaction is mediated by a triplet of neutral gauge bosons. The lower limit of the gauge boson mass is estimated to be ~ 4 GeV. Qualitative analysis of the decay modes of the recently discovered 3.1– and 3.7–GeV–mass particles and several consequences of the medium interaction are given. (auth)

Electromagnetic

Refer also to abstracts 23883, 23989, 24100, 24188, 24529, and 24557.

24006 (AD-774427) ENERGY-INTEGRATED LEGENDRE COEFFICIENTS FOR PHOTON SCATTERING FROM MAXWELLIAN ELECTRONS. Final Report, September 1972–April 1973. Webster, J. B. III; Stephan, B. G. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Feb 1974. 75p. (AFWL-TR-73-248). NTIS $3.75.

Energy-integrated coefficients for a Legendre expansion of the angular dependence of the differential cross section which describes Compton scattering from nonstationary electrons. The electrons are assumed to have a Maxwellian velocity distribution. An analytic fit is presented for the dependence of these coefficients on photon energy and electron distribution temperature. If a Legendre expansion of the scattering kernel in a transport calculation is used, these coefficients may be used to aid in determining the degree of expansion required for the particular situations to be encountered in the problem. The fits presented will yield integrated coefficients whose accuracy is good to approximately 1% for photon energies between 0 and 1000 keV, and for electron distribution temperatures between 0 and 20 keV. (auth)

24007 (CONF-730660-P1, pp A147-A165) REDUCTION OF THE WEINBERG UNIFIED LAGRANGIAN TO A SIMPLE MODEL. Mainland, G. B.; O'Raifeartaigh, L. (Dublin Inst. for Advanced Studies). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

It is emphasized that the unification and renormalization properties of the Weinberg Lagrangian are disjoint. The renormalization properties are then separately analyzed by reducing to a much simpler model. (auth)

24008 (CONF-730660-P2, pp B67-B79) MINIMAL COUPLING AND MAGNETIC CHARGE. Combe, P. (Univ., Marseille). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The most general form of the Lagrangian of a particle in a constant and uniform electromagnetic field is derived using a group theoretical argument based on Levy-Leblond's approach to the Lagrangian gauge problem. The so-called minimal coupling is derived. In the case of a pure magnetic field, it is shown that the principle of minimal coupling by the magnetic charge breaks down if the invariance of the equations of motion under space reflexion is to be required. (auth)

24009 (DESY-74/58) POMERON FACTORISATION AND THE REACTION $\gamma N \rightarrow$ phiN. Dass, G. V.; Fraas, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1974. 47p. Dep. NTIS (US Sales Only) $5.50.

Because of the suitability of $\gamma N \rightarrow \phi N$ for studying the Pomeron, one systematically investigates the tests for Pomeron factorization possible in this rather clean reaction, particularly from the more feasible experiment which measures the ϕ-density-matrix, and also an experiment measuring the recoil nucleon polarization; the complete set of initial polarization configurations was considered. For any two-body parity-conserving process, a simple consequence of factorization is M-purity which asymptotically corresponds to purely natural or purely unnatural parity in the crossed channel. Factorization tests, therefore, include M-purity tests, but M-purity does not necessarily imply factorization. For the ϕ-decay density-matrix all the possible factorization tests are given and it is shown that the tests are exhaustive. A separate measurement of the recoil nucleon polarization is shown to complement adequately the information obtained from the ϕ-decay density-matrix in the factorizing case. For the ϕ-density matrix, some of the M-purity tests refer to dominant amplitudes and persist even if s-channel meson-helicity-conservation (which is experimentally true approximately) holds exactly. These tests should be easy to perform. The tests which invoke factorization more crucially than only M-purity do not persist in that manner; these refer to the helicity nonconserving amplitudes. However, factorization for such small amplitudes could be advantageously tested here, because of their being masked by the large amplitudes elsewhere. The factorization tests for the ϕ-density-matrix can be used to distinguish a pure Regge pole type Pomeron from an M-pure "cut-pole mixture" type Pomeron or an M-impure (hence nonfactorizing) "cut-pole mixture" type Pomeron and also a factorizing "cut-pole mixture" type Pomeron or a nonfactorizing "cut-pole mixture" type Pomeron. Such tests would require polarized photons and/or targets. Present $\gamma N \rightarrow \phi N$ data are not adequate enough to allow firm conclusions about Pomeron factorization, though they do indicate M-purity for the Pomeron, corresponding to pure natural parity. This is consistent with Pomeron factorization, but M-purity is only a necessary consequence of factorization. Better and more $\gamma N \rightarrow \phi N$ data are needed to get a more complete picture of Pomeron factorization. (auth)

24010 (DESY-74/59) MEASUREMENT OF LARGE ANGLE e^+e^- SCATTERING AT THE 3100 MeV RESONANCE. Braunschweig, W.; Jordan, C. L.; Martyn, U. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Dec. 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

Elastic e^+e^- scattering was measured at total energies covering the newly found resonance at 3100 MeV. The angular distribution is consistent with spin-parity 1^-, and the cross section integrated over energy yields $\Gamma_{ee}^2/\Gamma_{tot} = 0.23 \pm 0.05$ keV for the resonance. (auth)

24011 COULOMB CORRECTIONS TO HADRON WIDTHS. Pilkuhn, H. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 82: No. 3, 365-369 (4 Dec 1974).

The Coulomb corrections to the widths of hadron decays are calculated from the penetration factor model. Numerical values are given for the partial widths of the Δ resonance quartet and for the decays $\phi \rightarrow K\bar{K}$, $\Xi^* \rightarrow \pi\Xi$, and $\Lambda \rightarrow \pi^-p$. (auth)

24012 MULTIHADRON PRODUCTION IN A CASCADE MODEL FOR e^+e^- ANNIHILATION. I. Total Cross Section and Multiplicity Distribution. Craigie, N. S. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik); Rothe, K. D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 82: No. 3, 370-380(4 Dec 1974).

A simple dynamical model is considered for e^+e^- annihilation in which the production of pions is the result of a kind of bremsstrahlung process, each step of the cascade being characterized by the decay of a (massive) spin-one system into a pion plus a similar spin-one system. The high energy behavior of the n-particle and total cross sections is studied as well as the multiplicity distribution for a large class of transition form factors. The model is found to include features familiar from the uncorrelated jet, the multiperipheral and the thermodynamical models. In particular, it is able to accomodate a logarithmically increasing multiplicity as well as a constant total cross section. (auth)

24013 MULTIHADRON PRODUCTION IN A CASCADE MODEL FOR e^+e^- ANNIHILATION. II. Multiplicity and Inclusive Distribution. Craigie, N. S. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik); Rothe, K. D. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 82: No. 3, 381-396(4 Dec 1974).

The asymptotic behavior of the n-particle and total cross sections for e^+e^- annihilation was studied within the framework of a cascade model, allowing for a large class of transition form factors. The discussion is extended to a study of the once inclusive process, restricted to the class of transition form factors leading to a multiplicity increasing logarithmically with the center-of-mass energy. The corresponding set of two-dimensional, coupled integral equations is solved explicitly. The behavior of the structure functions in the Bjorken limit is discussed, as well as the threshold behavior and moment sum rules satisfied by the corresponding scaling functions. In addition, some interesting conclusions are drawn which are expected to be valid beyond this model. It is found that the limit $s \rightarrow \infty$, $\omega \rightarrow 0$ is reached nonuniformly, so that the asymptotic behavior of $\langle n \rangle$ cannot be deduced from the scaling function $F(\omega)$ alone; Feynman scaling is broken for $\omega \rightarrow 0$; and for a smaller value of ω, the scaling limit is reached correspondingly slower. (auth)

24014 DYNAMICAL MECHANISMS IN HIGH-ENERGY $\pi^\pm N$ AND $\pi^\pm\Delta$ PHOTOPRODUCTION. Barbour, I. M. (Glasgow Univ. (UK). Dept. of Natural Philosophy); Malone, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nucl. Phys., B; 82: No. 3, 477-498(4 Dec 1974).

A fixed t dispersion relation calculation is performed for the high energy $\pi\Delta$ amplitudes using a quark model estimate for their low energy imaginary parts. It is found that the mechanisms governing high energy $\pi^+\Delta$ photoproduction are the same as those in π^+N photoproduction, namely the amplitudes in the extreme forward direction ($\sqrt{-t} \lesssim 0.2$ GeV/c) are given almost entirely by their Born approximation whereas for larger momentum transfers ($0.1 \leq -t \leq 0.7$ GeV/c) a strong cancellation exists between the Born and continuum contributions to the natural parity exchange amplitudes allowing the high energy imaginary parts to dominate. The complete Born approximation in the extreme forward region is shown explicitly to be equivalent to the minimal pion exchange model for ($\pi^+\Delta$) photoproduction. (auth)

24015 ELECTROMAGNETIC MASS SHIFT OF PIONS IN UNIFIED GAUGE FIELD THEORIES AND THE LIGHT-CONE. Palla, L.; Pocsik, G. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)). Nucl. Phys., B; 83: No. 1, 168-176(11 Dec 1974).

The electromagnetic mass shift of pions is discussed in unified gauge field theories of weak and electromagnetic interactions to second order of the electric charge and the pion mass, respectively. The contributions of the next to leading light-cone singularities (quark mass terms) are calculated, and it is found that these do not contribute to the divergences in the mass shift provided the masses of the bare proton quark and neutron quark are equal. γ, Z, W, ϕ exchanges are taken into account. Different bare quark masses in general make the mass shift divergent. In the tadpole contribution, the Born term causes a divergence unless the results are extrapolated first to $q^2 = 0$. (auth)

24016 TAIL, ZEROS AND SPACE-LIKE REGION BEHAVIOR OF THE ELECTROMAGNETIC PION FORM FACTOR. Dubnicka, S.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., B; 83: No. 2, 311-320(18 Dec 1974).

Combining the real and imaginary parts of the pion form factor from the resonant region, given by a simple formula obtained by means of the dispersion relation method, with some special assumptions in the asymptotic region and sum rules, the time-like region form factor tail is predicted. Further, the existence of form factor zeros is investigated and on the basis of numerical results one can conclude that zeros of the pion form factor exist. By means of the unsubtracted dispersion relation, the predicted space-like region behavior of the form factor is found to be in excellent agreement with the existing experimental data. (auth)

24017 ELECTROMAGNETIC NUCLEON MASS DIFFERENCE, SUM RULES FOR DEEP INELASTIC SCATTERING AND EQUAL-TIME COMMUTATORS. Motz, G.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., B; 83: No. 3, 525-540(25 Dec 1974).

In the one-photon approximation the connection between the finiteness of electromagnetic mass corrections and the light-cone behavior of the product of electromagnetic currents was studied. In the canonical case there are two sum rules which guarantee the complete absence of divergences. The sum rules are equivalent to the vanishing of certain equal-time commutators. Using the technique of the Jost–Lehmann–Dyson representation, problems with subtractions are avoided. (auth)

24018 ASYMMETRY IN SEMI-INCLUSIVE ANNIHILATION. Fishbane, P. M. (Virginia Univ., Charlottesville (USA). Dept. of Physics); Newmeyer, J. L. (Stanford Linear Accelerator Center, Calif. (USA)). Nucl. Phys., B; 83: No. 3, 396-412(25 Dec 1974).

Interference between one- and two-photon processes for e^+e^- annihilation into hadrons in a two-jet parton model leads to a charge asymmetry of detected final state hadrons along the directions of the incident leptons. The asymmetry near the lepton axis grows as $2 \ln^2 \frac{1}{2}\theta - 4 \ln\frac{1}{2}\theta \ln s/\Delta E^2$, so that in spite of the $O(\alpha)$ suppression relative to the Born cross section, the asymmetry can amount to a 2% effect at $\theta = 2^0$ for $\pi^\pm$ or $K^\pm$ inclusive measurements in a typical experiment. The precise size of the asymmetry depends on the parton charges. The results are only meant to apply in the region $\omega \geq 0.5$, where the parton model appears to be relevant at present experimental energies. (auth)

24019 PHOTOPRODUCTION AMPLITUDES: THEIR DETERMINATION FROM UNITARITY AND EXPERIMENTAL DATA. Alvarez-Estrada, R. F.; Carreras, B. (Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica Teorica); Goni, M. A. (Madrid Univ. (Spain)). Nucl. Phys., B; 83: No. 3, 461-474(25 Dec 1974).

The pion photoproduction amplitudes on nucleons at fixed energy below the two-pion threshold are studied. They are determined from unitarity and the experimental knowledge of the differential cross section, the recoil nucleon polarization, the polarized target asymmetry and the asymmetry for linearly polarized photons by using the contraction mapping principle. Other solutions and some ambiguities of the unitarity equations are studied. (auth)

24020 DUALITY SUM RULES IN e^+e^- ANNIHILATION FROM CANONICAL TRACE ANOMALIES. Etim, E.; Greco, M. (CNEN, Rome). Lett. Nuovo Cim.; 12: No. 3, 91-95(18 Jan 1975).

Assuming that a complete breakdown of scaling is postponed to much higher energies, it is shown how in the framework of the canonical trace anomaly of the energy–momentum tensor the asymptotic value of the ratio $R = \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$ can be related to the low energy behavior of $\sigma(e^+e^- \to \text{hadrons})$ through a duality principle which is derived explicitly. (JFP)

24021 PHOTOPRODUCTION OF PSEUDOSCALAR MESONS OF HIGH ENERGY. Ray, S. Montreal; McGill Univ. (1973). 130p.

Thesis.

Firstly, forward photoproduction of neutral pi and eta mesons is simultaneously described in terms of models involving Regge poles and Regge cuts. Two distinct models are used to produce good fits to the existing data—the dual absorptive model (DAM) and the weak cut model (WCM). This analysis is extended to certain quantities of the processes $\pi N \to \omega N$ and $\pi N \to \rho N$ through the use of vector dominance relations. The suitability of using the absorption prescription to calculate the Regge cut contributions corresponding to Reggeized vector exchanges for the imposition of the DAM requirements is discussed. The DAM results are compared to those of the WCM and some tests for experimentally distinguishing between these two models are suggested. Secondly, photoproduction of charged pions in both forward and backward directions is discussed in detail in terms of the Veneziano model, a crossing symmetric dual model. A simple model with a small number of beta functions (and essentially without any free parameters) is seen to explain the forward structure of different experimental quantities and also to correctly predict the residues of some higher baryon resonances. In the backward direction, the introduction of some satellite terms is seen to be necessary to account for the differential cross sections. (auth)

24022 MODELS OF ELECTROMAGNETIC AND STRONG INTERACTIONS OF HADRONS. Snell, V. G. Toronto; Univ. of Toronto (1972). 112p.

Thesis.

The electromagnetic interactions of hadrons are investigated. The formalism for the elastic scattering of photons from hadrons is described for the case where the target hadron is pointlike in structure, and for the case where it is extended. The experimental data on these interactions (for nucleons and pions) are presented, and models used to describe it are discussed. A high energy model for nucleon and pion Compton scattering having Regge behavior, crossing symmetry, and a nonzero scale invariance limit is then constructed. Good fits are obtained with this model to the total photon–nucleon cross section, to the differential cross section for proton Compton scattering, and to the structure functions for inelastic electroproduction in the nonresonant region; for pions, the total cross section in the annihilation region, for production of a pion plus any hadrons, is calculated and found to agree with the preliminary data. The consequences of analyticity in the energy variable are examined. Sum rules are constructed which require terms in the high energy expansion of the scattering amplitude other than Regge poles, although the latter remain as a good approximation to the data. It is found that cuts in the angular momentum plane are good candidates for such terms. The connection between the high momentum–transfer-fall-off of the nucleon (and pion) electromagnetic form factors and the rate of approach to scale invariance is pointed out. Mentioned briefly are the results of application of a model for strong interactions to $\pi\pi$ and $K\pi$ scattering. (auth)

24023 EFFECTIVE ρ–ω INTERFERENCE AND PION FORM-FACTOR. Blazek, M.; Bohacik, J. (Inst. of Physics, Bratislava). Acta Phys. Slovaca; 23: No. 3, 168-172(1973).

The most recent Orsay data on the electromagnetic pion form factor are explained by the ρ–ω interference, with both objects considered as having the effective mass and width. Leaving the ρ mass and width as free parameters, the best fit procedure gives $m\rho = 775.6$ MeV and $\Gamma\rho = 126.8$ MeV. (Nucl. Sci. Abstr. Czech)

24024 SPECTRUM OF HEAVY MESONS IN e^+e^- ANNIHILATION. Harrington, B.J.; Park, S.Y.; Yildiz, A. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. Lett. 34: No. 3, 168-171 (20 Jan 1975).

The picture that charmed quarks are interacting with each other through a linear potential is used to analyze the particle spectrum in the high–energy annihilation process $e^+e^- \to$ hadrons. With the newly found resonances at 3.1 and 3.7 Gev as input, we predict other

resonances (in particular, one at approximately 4.0 GeV) and determine the hadronic width of the 3.1 and leptonic widths of the 3.1 and 3.7 resonances. Extending the linear potential to quarks without charm enables us to predict the charmed–particle threshold to be approximately 5 GeV. (auth)

24025 COMMENT ON RADIATIVE CORRECTIONS TO $e^+e^- \rightarrow \psi$ (3105). Yennie, D.R. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 34: No. 4, 239-241 (27 Jan 1975).

The salient features of the radiative corrections to the line shape of the reaction $e^+e^- \rightarrow \psi$ (3105) are described, emphasizing the importance of treating the infrared divergence to all orders. A tentative value of 5.2 keV is obtained for the partial width for the ψ to decay to e^+e^-. An interesting but possibly fortuitous relation among the leptonic decay widths of the ρ^0, ω, φ, and ψ is noted. (auth)

24026 ELECTRON–ELECTRON SCATTERING. II. HELICITY CROSS SECTIONS FOR POSITRON–ELECTRON SCATTERING. DeRaad, L.L. Jr. (Department of Physics, University of California, Los Angeles, California 90024); Ng, Y.J. Phys. Rev. D 10: No. 10, 3440-3447 (15 Nov 1974).

The differential cross sections for polarized electron–positron scattering are calculated to order e^6 by using the five invariant amplitudes presented in a previous paper. The unpolarized result of Polovin is rederived. As an application of the helicity amplitudes the spin–momentum correlation for a polarized target positron is obtained in agreement with Fronsdal and Jaksic. (auth)

24027 TIME–REVERSAL INVARIANCE–LIKE RELATIONS FOR SPIN–EFFECTS IN ELASTIC AND INELASTIC REACTIONS; VECTOR–MESON PHOTOPRODUCTION VERSUS COMPTON SCATTERING FROM NUCLEONS. Dass, G.V (Deutsches Elektronen Synchrotron DESY, Hamburg, Germany); Fraas, H. Ann. Phys. (N.Y.) 88: No. 2, 554-587 (Dec 1974).

For elastic scattering, relations between spin–effects (for example, the well–known asymmetry–polarizaton equality) follow from time–reversal invariance. We show that, if certain amplitude combinations vanish, there are stikingly similar relations between spin–effects for elastic and also inelastic reactions. This vanishing of amplitude combinations (denoted M–purity) corresponds asymptotically to purely natural or purely unnatural parity in the crossed channel. The M–purity relations hold for spin–configurations much more general than do the corresponding time–reversal invariance relations. The experimental evidence for purely natural parity exchanges in high-energy vector meson photoproduction from nucleons is shown to be good for all amplitudes involving nonzero meson helicity, but less conclusive for the zero-helicity ones. Using time–reversal invariance and a vector meson–dominance argument, this implies no unnatural-parity contributions in high-energy Compton scattering from nucleons. Because of this empirical evidence for M–purity in these two processes, a detailed application to spin–effects in Compton scattering and in vector meson photoproduction is made. Some time–reversal invariance relations in Compton scattering resemble the corresponding M–purity relations though the applicability of the two is different, and there are examples where only one of the two exists. Out of our illustrations, the only M–purity relations which change in form due to the extra amplitudes present in the inelastic reaction are the M–purity analogue and extensions of the asymmetry–polarization equality (of Compton scattering) referring to the photon; the change is the appearance of the elements ρ^{00} of the vector meson density–matrix ρ. Our other examples of M–purity relations do not change in form in going over from the elastic reaction (Compton scattering) to the inelastic reaction (vector meson photoproduction). (auth)

24028 SIXTH–ORDER MAGNETIC MOMENT OF THE ELECTRON. Cvitanović, P. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850 and Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305); Kinoshita, T. Phys. Rev. D 10: No. 12, 4007-4031 (15 Dec 1974).

We have evaluated the contribution of 50 Feynman diagrams of three–photon–exchange type to the electron magnetic moment by two independent methods. The results are mutually consistent and are several times more accurate than previously reported calculations. If we combine the analytic result of Levine and Roskies for 10 diagrams and our numerical result for the remaining 40 diagrams, we obtain the best estimate available at present: $(0.922 \pm 0.024)(\alpha/\pi)^3$. Including the contribution from the remaining 22 diagrams calculated previously, the complete theoretical prediction for the electron anomaly up to the order α^3 is $(1/2\alpha/\pi - 0.32848(\alpha/\pi)^2 + (1.195 \pm 0.026)(\alpha/\pi)^3$, in fair agreement with the latest experimental result. (auth)

24029 REMARKS ON THE 3105–MeV RESONANCE. Pham, T.N.; Pire, B.; Truong, T.N. (Centre de Physique Théorique de l'Ecole Polytechnique, Paris, France). Phys. Rev. Lett. 34: No. 6, 347-348 (10 Feb 1975).

The 3105–MeV narrow resonance discovered at Brookhaven National Laboratory and Stanford Linear Accelerator Center is analyzed. A new type of interaction is suggested to account for its decay properties and production cross section. (auth)

24030 IS THE PHOTON g–SPIN BLIND? Soni, A. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 6, 352-354 (10 Feb 1975).

I consider a six–quark model for hadrons. The three new ones possess charges +, 0, −, and an additional quantum number g (for "gentleness"). To explain the recently observed resonances, a selection rule is proposed: Electromagnetism violates g spin and the photon is blind to gentleness. Experimental tests for the idea are discussed. (auth)

24031 SPECTRUM OF CHARGED QUARK–ANTIQUARK BOUND STATES. Eichten, E.; Gottfried, K.; Kinoshita, T.; Kogut, J.; Lane, K. D.; Yan, T. M. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. Lett. 34: No. 6, 369-372 (10 Feb 1975).

The discovery of narrow resonances at 3.1 and 3.7 GeV and their interpretation as charmed quark–antiquark bound states suggest additional narrow states between 3.0 and 4.3 GeV. A model which incorporates quark confinement is used to determine the quantum numbers and estimate masses and decay widths of these states. Their existence should be revealed by γ–ray transitions among them. (auth)

24032 SPECTROSCOPY OF THE NEW MESONS. Appelquist, T.; De Rújula, A.; Politzer, H.D. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138); Glashow, S.L. Phys. Rev. Lett. 34: No. 6, 365-369 (10 Feb 1975).

The interpretation of the narrow boson resonances at 3.1 and 3.7 GeV as charmed quark–antiquark bound states implies the existence of other states. Some of these should be copiously produced in the radiative decays of the 3.7–GeV resonance. We estimate the masses and decay rates of these states and emphasize the importance of γ–ray spectroscopy. (auth)

Weak

Refer also to abstracts 24099 and 24543.

24033 (CERN-75-1) CALCULATION OF THE NEUTRON-INDUCED BACKGROUND IN THE GARGAMELLE NEUTRAL CURRENT SEARCH. Fry, W. F.; Haidt, D. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Jan 1975. 23p. Dep. NTIS (US Sales Only) $4.25.

A calculation is presented of the neutron-induced background in the Gargamelle heavy-liquid bubble chamber, in connection with the search for neutral currents in neutrino interactions. In particular, the cascade effect of high energy nucleons was included. Results of an experiment to verify these cascade calculations are discussed. The conclusion is that the observed neutral current candidates cannot be explained by neutron-induced background. (auth)

24034 (JINR-P2-7345) POSSIBILITY OF SUPPRESSION OF BACKGROUND FROM $K \rightarrow l\nu_l\pi^0$, $\pi^0 \rightarrow \gamma e^+e^-$ PROCESSES DURING INVESTIGATION OF $K \rightarrow l\nu_l e^+e^-$. Shumeiko, N. M.; Bardin, D. Yu.; Mitsel'makher, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). INIS.

The kinematics of the decay $K \rightarrow l\nu_e e^+e^-$ and the background process $K \rightarrow l\nu_e\pi^0$, $\pi^0 \rightarrow \gamma e^+e^-$ were analyzed. The possibility of experimental suppression of the background level was discussed. The calculations showed that the background/effect ratio can be made satisfactorily small. (tr-auth)

24035 (JINR-P2-7351) RADIATIVE CORRECTIONS TO μ-DECAY. Malyshkin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 9p. (In Russian). INIS.

Radiation corrections to the decay spectrum of polarized μ-mesons are considered. Parts of the radiation corrections leading to infrared divergences are summed over all orders according to a constant fine structure a. The remainders were calculated to the first order. (5 refs.) (tr-SJR)

24036 COMPLEX CABIBBO ANGLE AND CP VIOLATION IN A CLASS OF GAUGE THEORIES. Frenkel, J.; Ebel, M. E. (Wisconsin Univ., Madison (USA). Dept. of Physics). Nucl. Phys., B; 83: No. 1, 177-188(11 Dec 1974).

A class of gauge theories which incorporate CP violation is discussed. The CP violating effects arise as a consequence of performing a different rotation in the SU(3) space for the left- and right-handed strangeness conserving charged currents. It is suggested that it is possible to understand the smallness of these effects in the $\bar{K}_0$-K_0 system even in the presence of a large relative phase between the left- and right-handed weak currents. The electric dipole moments of hadrons are of fifth order in the

semi-weak coupling constant whereas for leptons they are of seventh order. These electric dipole moments are considerably smaller than the experimental upper limits. (auth)

24037 WEAK RADIATIVE DECAYS OF Σ AND Λ HYPERONS. Reid, J. H. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik); Trofimenkoff, N. N. (CEGEP de Hull, Hull, Quebec, Canada). Nucl. Phys., B; 82: No. 3, 397-421(4 Dec 1974).

Unitarity and dispersion theory are used to calculate the contribution of the πN intermediate state to the weak radiative decays of Σ and Λ hyperons. The contribution from the octet baryon poles is also calculated. The current X current form is assumed for the weak Hamiltonian so that the weak parity-violating two-body vertex vanishes in the limit of SU(3) symmetry and the parity-violating octet baryon pole terms are zero. Consequently the parity-violating weak radiative decay amplitude comes entirely from the πN intermediate state. The main results are: the contribution of the πN intermediate state is comparable to the contribution of the octet baryon pole terms and the correct sign and order of magnitude for the asymmetry parameter α and a branching ratio in moderate agreement with the recent experiment of Gershwin et al. are obtained for the decay $\Sigma^+ \to p\gamma$. (auth)

24038 ELECTRON POLARIZATION IN POLARIZED MUON DECAY: RADIATIVE CORRECTIONS. Fischer, W. E.; Scheck, F. (Schweizerisches Inst. fuer Nuklearforschung, Villigen). Nucl. Phys., B; 83: No. 1, 25-31(11 Dec 1974).

The first-order radiative corrections to the decay spectrum of polarized muons are calculated for the case where the electron polarization is also observed. The significance of the results for further studies on muon decay is discussed. (auth)

24039 ARE THE WEAK NEUTRAL CURRENTS AN ELECTROMAGNETIC EFFECT. Jouvet, B. (College of France, Paris). Lett. Nuovo Cim.; 12: No. 3, 81-85(18 Jan 1975).

In the consideration of weak neutral currents as a possible electromagnetic effect, attention is called to the fact that the new revolution of quantum electrodynamics might not necessarily be that which most people believe. The question of renormalizability is discussed. The kinetics of neutrino interactions with hadrons is considered. (JFP)

24040 GAUGE THEORIES AND M−SPIN CONSERVATION. Meshkov, S. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510 and National Bureau of Standards, Washington, D.C. 20234); Rosen, S.P. Phys. Rev. D 10: No. 10, 3520-3521 (15 Nov 1974).

M−spin conservation is shown to be a property of Salam−Weinberg gauge theories. Amplitude relations such as $A(\nu_e e^- \to \nu_e e^-) - A(\nu_e e^- \to \nu_e e^-) = A(\nu_e e^- \to \nu_\mu \mu^-)$ derived from M−spin invariance alone also hold for the gauge theories up to the breaking due to Higgs scalars. (auth)

24041 NEUTRINO CHARGE RADIUS IN A MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Aubrecht II, G.J.; Tanaka, K. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 10: No. 10, 3522-3525 (15 Nov 1974).

We introduce a modified SO(3) model of weak− and electromagnetic−interaction symmetry. The model is renormalizable and reproduces the usual theory of weak interactions. Four additional heavy leptons and five additional quarks are necessary. The electromagnetic charge radius of the neutrino is calculated in the ξ−limiting procedure and a finite result is found. (auth)

24042 MODEL OF WEAK INTERACTIONS BASED ON EXACT PARTIAL CONSERVATION OF AXIAL−VECTOR CURRRENT. Carlson, C.E. (Physics Department, College of William and Mary, Williamsburg, Virginia 23185); Fronsdal, C. Phys. Rev. D 10: No. 12, 4252-4256 (15 Dec 1974).

A model in which weak interactions couple via spinless particles is examined, and we propose a new theory which requires no unknown particles. The first−order interaction is made CP−odd but, to the extent that partial conservation of axial−vector current and partial conservation of vector current are valid, it is not observable even if the spinless intermediaries are light. We identify the intermediaries as the SU(3) × SU(3) double nonet of scalar and pseudoscalar mesons. A natural explanation of the magnitude of the CP−violating effects emerges, and some speculations concerning hadronic weak interactions are made. (auth)

24043 POSSIBLE AXIAL COUPLINGS OF THE NEW RESONANCES. Paschos, E.A. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). Phys. Rev. Lett. 34: No. 6, 358-361 (10 Feb 1975).

The possibility is raised that the new meson resonances are of weak origin, and measurements are proposed which can clarify this issue. Experimental situations are found where the forward−backward asymmetry is sizable. Theoretical expectations for the longitudinal polarization of the muon and decay modes of the resonances are discussed. (auth)

Strong (General)

Refer also to abstracts 24024, 24094, 24510, 24541, and 24549.

24044 ON THE HADRON-PARTON RECIPROCITY RELATION. Eylon, Y.; Zarmi, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., B; 83: No. 3, 475-492(25 Dec 1974).

The possibility of an equality between the distributions of partons inside hadrons and the distributions of hadrons in parton fragmentation is studied. It is consistent with existing electroproduction data when the momentum fractions involved are not too small. Implications for current−hadron interactions, large p_T hadronic cross sections and heavy lepton pair production in hadron−hadron collisions are discussed. (auth)

24045 THE SHRINKAGE OF THE ELASTIC DIFFERENTIAL CROSS SECTION FROM THE MULTIPERIPHERAL MODEL USING UNITARITY. Sohlo, S. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Nucl. Phys., B; 83: No. 2, 276-284 (18 Dec 1974).

The overlap function has been calculated analytically from a simplified Chan−Loskiewicz−Allison (CLA) model with Regge phase. Hamer and Peierls have shown, by using the impact parameter variables, that in the CLA model with Regge phase the slope of the overlap function increases too rapidly with total energy when compared to experiment. According to Jadach and Turnau this was due to inadequate approximations made for the norm of the CLA amplitude, and they showed that in the CLA model with no momentum-dependent phase the shrinkage agrees with experiments but the magnitude of the slope is too small. It is shown without making the inadequate approximations mentioned by Jadach and Turnau that, when the Regge phase is used in the CLA model, it makes the overlap function shrink too rapidly and have too large a slope above 20 GeV/c. Clustering will improve the agreement with experiment, especially when one further assumes that the clusters do not form resonances; then the trajectories which are exchanged between two clusters are exchange degenerate and have a real contribution to the amplitude. The analytic calculations made it possible to discuss contributions to the overlap function from various properties of the production amplitude. (auth)

24046 STABLE ANALYTIC EXTRAPOLATIONS IN THE THEORY OF STRONG INTERACTIONS. Nenciu, G. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 26: No. 5, 479-516(1974). (In Rumanian).

The discussion covers analytic properties of the scattering amplitudes, conformal mappings, experimental data and errors, improper problems in mathematical physics, stabilization of the analytic continuation, analytic continuation, an improperly posed problem, stable analytic continuation, actual methods of analytic continuation, weighted dispersion relations, the optimal analytic extrapolation from boundary to interior points, extrapolation to the boundary using weighted dispersion relations, a probabilistic approach to analytic continuation and lower bounds for hadronic contribution to anomalous magnetic moment of μ-on. (auth)

24047 DUAL ABSORPTIVE MODEL FOR BACKWARD HADRON SCATTERING. Rafique, M.; Saleem, M.; Bhatti, S. (Punjab Univ., Lahore). Aust. J. Phys.; 27: No. 5, 657-661(Oct 1974).

It is shown that a dual absorptive model can explain the dip structure of backward differential cross sections of hadronic processes. The polarizations in those backward processes in which the dominant contribution comes from nonflip amplitude are also found to be qualitatively consistent with experiment. (auth)

24048 DIFFRACTION DISSOCIATION AND PARTONS. Resnick, L. (Carleton Univ., Ottawa). Can. J. Phys.; 52: No. 24, 2479-2494(15 Dec 1974).

A descriptive model of high energy diffractive reactions among hadrons is presented, with particular attention to diffraction dissociation into definite channels (exclusive reations). The motivation is based upon the ideas of Good and Walker, and others, but hadrons are now assumed to be composed of elementary point-like constituents called partons. The physical eigenstate of a hadron is assumed to be a noneigenstate of parton number, so the latter is a fluctuating quantity in a given reaction. The basic interaction in a high energy collision of two hadrons is assumed to be between partons. However, detailed parton-parton dynamics is avoided by invoking the optical theorem for forward angles. For diffraction dissociation, the basic problem is the construction of a "compound" physical state in terms of supposedly known "simple" physical states. A prescription is given, using the argument

of random phases, and the amplitude for diffraction dissociation is found as an overlap, simultaneously, of momentum space wave functions and parton number distribution functions. Simple examples are given for Gaussian and Poisson functions. The model can account for several features of exclusive diffraction dissociation reactions but spin is neglected at this stage. (auth)

24049 RELATIVISTIC COMPOSITE SYSTEMS AND MINIMAL COUPLING. Barut, A.O.; Duru, I.H. (Department of Physics, University of Colorado, Boulder, Colorado 80302). Phys. Rev. D 10: No. 10, 3448-3454 (15 Nov 1974).

The problem of minimal coupling of relativistic composite systems having internal degrees of freedom is investigated. The ambiguity in the introduction of various internal coordinates with the same mass spectrum can be solved by probing the system with external electromagnetic interactions. For the generalized Majorana equation this procedure shows that the charged constituent of the system performs a two-dimensional Kepler motion in the Klein-Gordon approximation and not an oscillator motion. (auth)

24050 CHARGE-SYMMETRY VIOLATIONS IN THE ACHIMAN MODEL. Aubrecht II, G.J.; Razmi, M.S.K. (Institute of Theoretical Science and Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. D 10: No. 10, 3495-3500 (15 Nov 1974).

We investigate the implications of the Achiman model in the deep-inelastic region using the light-cone algebra. The model predicts $\sin^2\theta_W \sim 0.7$. Charge-symmetry violations are calculated, and found to be rather large. (auth)

24051 SYMMETRIC VERTEX COUPLINGS FOR ALL SPINS AND PARITIES. Morrow, R.A. (Bennett Hall, University of Maine, Orono, Maine 04473). Ann. Phys. (N.Y.) 88: No. 2, 472-503 (Dec 1974).

Interaction Hamiltonians for three particles having arbitrary spins and parities are constructed based on the rather stringent requirement of permutation symmetry. There are only two free parameters in each Hamiltonian: an overall coupling constant and a scaling parameter (identified as the inverse slope of a Regge trajectory). Vertex functions are evaluated in lowest-order perturbation theory, and their use in formulating Reggeized scattering amplitudes is reviewed. In the particular case of three normal-parity bosons the calculated vertex functions coincide with the vertices extracted from a 6-point dual resonance amplitude. The results presented here may be used, for example, to predict the two-body decay characteristics of resonances and, in a more theoretic vein, to serve as a base upon which to build dual resonance amplitudes for particles of all spins and parities. (auth)

24052 STRINGS, MONOPOLES, AND GAUGE FIELDS. Nambu, Y. (The Enrico Fermi Institute and the The Department of Physics, The University of Chicago, Chicago, Illinois 60637). Phys. Rev. D 10: No. 12, 4262-4268 (15 Dec 1974).

The Nielsen-Olesen interpretation of dual strings as Abrikosov flux lines is extended to the case of open-ended strings by adapting Dirac's description of magnetic monopoles to a London-type theory. The mathematical formalism turns out to be similar to that of Kalb and Ramond. Translated to hadron physics, the quarks will act as carriers of magnetic charge, permanently bound in pairs by the string bonds. However, massive axial-vector gluons can be created by hadrons. (auth)

24053 EXTENDED MODEL OF ELEMENTARY PARTICLES BASED ON AN ANALOGY WITH SUPERCONDUCTIVITY. Eguchi, T. (Department of Physics, University of Tokyo, Hongo, Tokyo, Japan); Sugawara, H. Phys. Rev. D 10: No. 12, 4257-4262 (15 Dec 1974).

An extended model of elementary particles based on an analogy with superconductivity is presented. Starting from the modified Nambu-Jona-Lasinio model of a massless fermion field with the quartic self-interactions, we derive coupled differential equations for the self-consistent fermion mass based on the relativistic Hartree-Fock-Bogoliubov approximation. The physical implication of these equations is explored and is shown to suggest a stringlike picture for the extended hadrons. (auth)

24054 CONDUCTIVE STRING: A RELATIVISTIC QUANTUM MODEL OF PARTICLES WITH INTERNAL STRUCTURE. Carlson, C.E. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185); Chang, L.N.; Mansouri, F.; Willemsen, J.F. Phys. Rev. D 10: No. 12, 4218-4230 (15 Dec 1974).

A relativistic quantum-mechanical model for a one-dimensionally extended composite hadron is studied in detail. The model is suggested by the string model, and has the same spectrum of excitations in the large-quantum-number limit, but has features which represent departures from the string model as well. The ground state of the system has the character of a conductive medium. Quasiparticle excitations in filled Fermi-sea configurations give rise to towers of particles of increasing mass and spin. Lorentz-scalar collective excitations with Bose statistics are also supported by the system, and can lead to a Hagedorn-type degeneracy in the spectrum. The fundamental dynamical variables of the theory are canonical Fermi fields, but an internal consistency requirement of the theory demands all physical states must have zero fermion ("quark") number. The theory is relativistically covariant in four-dimensional Minkowski space, without requiring ghosts or tachyons. (auth)

24055 TRANSVERSE SCALING AT LOW ENERGIES. Likhoded, A.K.; Tolstenkov, A.N. (Institute of High Energy Physics). JETP Lett. 20: No. 6, 195-197 (20 Sept 1974).

It is shown that the dependence on the transverse mass $m_\perp = \sqrt{m^2+p^2}$ in two-reggeon vertices $f_{a_1 a_2}(m_\perp)$, which appear in the description of the central region of inclusive spectra, can be accounted for within the framework of the multiperipheral model with an exponential internal cutoff. At $m_\perp > 0.4$ GeV, the relation between the $f_{a_1 a_2}$ is such that the complete answer for the cross section has a transverse-scaling form. (auth)

24056 STATISTICAL MODEL OF THE MANY-PARTICLE GENERATION. Montvay, I. (Eotvos Lorand Tudomanyegyetem, Budapest). Fiz. Szemle; 24: No. 8, 231-238(Aug 1974). (In Hungarian).

Because of the difficulties involved in the measurement or theoretical calculation of the properties (momentum, energy, spin, and internal quantum number) of particles generated in the resonance decay of hadrons, several statistical models were developed for this purpose. One of these, the statistical bootstrap model, which considers the decay of the fireball generated by colliding high energy hadrons, is discussed, reviewing first the experimentally observed properties of the many-particle generation process, such as Feynman scaling, limiting fragmentation, and the leading particle effect. Because of lack of data and theoretical difficulties, the bootstrap model could not consider all resonances. Therefore, Hagedon developed a simplified statistical model by analogy with black-body radiation. This was further improved by Frantschi. The integral equation system was simplified by assuming a complete reciprocity between the generation and decay of fireballs. After examining the "nova" model, it was concluded that at present the theory is only phenomenological, describing but not explaining the events. No all-encompassing theory is yet available. (TTT)

Strong (Baryon No. = 0)

Refer also to abstracts 24098 and 24542.

24057 MEASUREMENT OF THE S-WAVE, I = 0, $\pi\pi$ SCATTERING LENGTH. Jones, J. A.; Allison, W. W. M.; Saxon, D. H. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., B; 83: No. 1, 93-107(11 Dec 1974).

New data are presented on the reactions $\pi^-p \to \pi^+\pi^-n$, $\pi^-p \to \pi^-\pi^0p$ at 415 MeV/c incident momentum. These data, together with events at higher momenta, are analyzed using the isobar model of Deler and Valladas. The I = J = O$\pi\pi$ interaction is represented by a function of the $\pi\pi$ mass, and the scattering length, a_0^0, was determined. One finds a value consistent with zero and $-0.06\ m_\pi^{-1} < a_0^0 < 0.03\ m_\pi^{-1}$. Certain features of the fit are investigated in terms of a rescattering graph. (auth)

24058 PION-PION PHASE SHIFT AND $K_{2\pi}$ DECAY. Pascual, P. (Barcelona Univ. (Spain). Departamento de Fisica Teorica); Yndurain, F. J. (Universidad Autonoma de Madrid (Spain)). Nucl. Phys., B; 83: No. 2, 362-364(18 Dec 1974).

Using the Cabibbo transformation properties for the weak Hamiltonian $\Delta_0 = \delta_0^{(0)}(s = M_K^2) - \delta_0^{(2)}(s = M_K^2)$ can be obtained from the experimental decay rates for $K \to 2\pi$, $K^+ \to \pi^0\pi^+$, giving $\Delta_0 = 58.0^0 \pm 4.6^0$. This result implies in particular a value of ~0.6 for the S-wave isospin zero scattering length, in accordance with K_{e4} results but in violent disagreement with Weinberg's calculation. (auth)

24059 DIFFRACTIVE AND NON-DIFFRACTIVE PION PRODUCTION ON DEUTERONS. Alberi, G. (Trieste Univ. (Italy). Istituto di Fisica Teorica); Rosa, L. P. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 83: No. 2, 218-240(18 Dec 1974).

An ensemble of formulae is presented for the calculation of the Glauber correction to incoherent production on deuterons. The formulae are written in terms of phases, slopes and integrated cross sections and both the diffractive and nondiffractive case are considered. It is shown in the case $K^+ \to K^0\pi^+$, that only if the analysis is done in such a way that the final set of states is complete, is there agreement between theory and experiment. (auth)

24060 CROSSING SUM RULES AND THE $\pi^0\pi^0 \to \pi^0\pi^0$ G-WAVE. Pidcock, M. K. (University Coll., London (UK). Dept. of Physics). Nucl. Phys., B; 83: No. 2, 253-268(18 Dec 1974).

A number of new crossing sum rules for the $\pi^0\pi^0 \to \pi^0\pi^0$ scattering amplitude are given and used to derive rigorous inequalities for the $l = 4$ partial wave in the unphysical region. A simple Veneziano model unitarized in the way suggested by Lovelace is found to satisfy these constraints. (auth)

24061 CONSTRAINTS IMPOSED BY THE DATA ABOVE 1 GeV ON THE LOW-ENERGY $\pi\pi$ AMPLITUDES. Bonnier, B.; Johannesson, N. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 83: No. 3, 440-452(25 Dec 1974).

The influence of the region above 1 GeV on low energy $\pi\pi$ amplitudes is studied by using minimum subtracted dispersion relations, in addition to the twice subtracted ones. When the results are compared with the recent phase-shift analysis below 1 GeV, it is found that the S-wave isospin-zero scattering length has to lie between 0.5 and 0.8. (auth)

24062 PARAMETRIZATION OF LONGITUDINAL-RAPIDITY DISTRIBUTIONS. Kirk, H. G.; Matziolis, M. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 12: No. 3, 75-80 (18 Jan 1975).

The longitudinal rapidity distributions of pions produced in high energy collisions of hadrons are known to have approximately Gaussian shapes at lower energies with a plateau apparently developing at very high energies. It may be useful for the phenomenological description of particle production at high energies to find a single formula which can accommodate both of these features. It is shown that the rapidity distributions can be parametrized by a simple Gaussian-like function. The parameter values obtained for pp, π^+p, and K^+p inclusive interactions are given. The calculated cross sections are shown. (JFP)

24063 APPLICATIONS OF MOFFAT'S PION-PION SCATTERING MODELS TO $\eta \to 3\pi$, AND $\bar{p}n \to 3\pi$: CALCULATIONS OF DOUBLE-β DECAY BASED ON THE PION-CORE MODEL OF $\Delta(1236)$. Smith, D. M. Victoria, B. C.; Univ. of Victoria (1973). 215p.

Thesis.

Moffat's Regge pole models for pion-pion scattering are applied to the final state interactions of the annihilation at rest $\bar{p}n \to \pi^+\pi^-\pi^-$ and the decays $\eta \to \pi^+\pi^-\pi^0$, $K^+ \to \pi^+\pi^+\pi^-$, $K^+ \to \pi^+\pi^0\pi^0$, and $K^0 \to \pi^+\pi^-\pi^0$. The pion-pion scattering models are extended to the above processes by applying crossing and by extrapolating the mass of one of the pions from its mass shell, without changing any of the parameters of the models. Double-beta decay based on a pion-core model of the $\Delta(1236)$, the pion-nucleon resonance with $J = I = 3/2$, is discussed. It is assumed that nuclei contain a small probability admixture of the $\Delta(1236)$, and that the $\Delta(1236)$ disassociates into a pion and a core particle. This model is applied to no-neutrino and two-neutrino double-beta decay. The calculation of no-neutrino double-beta decay involves a lepton nonconserving first-order superweak process. Comparison of the theoretical half-life of ^{130}Te with the experimental value indicates that if such an interaction exists then its coupling strength is about $10^{-12.9}$ times the usual weak coupling strength. Also considered is two-neutrino double-beta decay induced by a doubly-charged muon-electron current which violates the usual lepton number scheme but satisfies the Konopinski-Mahmoud scheme. (MGH)

24064 DUAL, CROSSING SYMMETRIC REPRESENTATIONS WITH FINITE WIDTH RESONANCES. Graskell, R. W. Hamilton, Ont.; McMaster Univ. (1973). 129p.

Thesis.

Dual, crossing symmetric representations with resonances having finite width are proposed and developed in detail. In particular, the asymptotic behavior over the whole complex energy plane is studied and it is shown that certain recently proposed scattering amplitudes lead to non-Regge contributions in most (or all) of the physically important regions of the kinematical variables. Conditions for Regge behavior are developed, a class of models satisfying these conditions (along with other physically important requirements) is presented, and a simple model obeying them is studied in detail. A number of physical applications are also presented, including an explanation of the Dalitz plot distribution for $\bar{p}n \to 3\pi$, the behavior of the most important $\pi\pi$ phase shifts and a determination of the $\pi\pi$ S-wave scattering lengths. (auth)

24065 π-π SCATTERING IN THE SU_2 σ MODEL. Chan, L.; Haymaker, R.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 10: No. 12, 4170-4176 (15 Dec 1974).

We explore the freedom of choosing subtraction points in the renormalizable σ model of $\vec{\pi}$ and σ. Phase shifts are computed from Padé approximants in the one-loop approximation. Comparisons are made with a previous calculation and an SU_3 σ-model calculation. The phase of the scalar form factor of the pion is presented. (auth)

24066 MESON DYNAMICS IN THE $SU_3 \times SU_3$ σ MODEL Chan, L.; Haymaker, R.W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. D 10: No. 12, 4143-4170 (15 Dec 1974).

We present the calculation of phase shifts for the renormalizable SU_3 σ model with the symmetry-breaking term $L_{SB} = -\epsilon_0\sigma_0 + \epsilon_8\sigma_8$. Perturbation theory is carried out to the one-loop approximation and phase shifts are obtained from Padé approximants. We renormalize at physical quantities: masses of π, K, η, η', decay constant f_π, and the $\pi\pi$, $I = 0$, $l = 0$ S-wave scattering amplitude near threshold. As a consequence of this choice, perturbation theory is a power series in $1/f_\pi^2$. A further consequence is that there are low-energy off-mass-shell points where the tree approximation is exact as we show. The symmetry-breaking picture is that of a nearly $SU_2 \times SU_2$-invariant Hamiltonian and a nearly SU_3-invariant vacuum. The $SU_3 \times SU_3$ limit is the Goldstone type. The corrections to decay constants and symmetry-breaking parameters are small. We can account for the size of corrections to all quantities of interest in a simple way. We achieve consistency between 2 measures of SU_3-symmetry breaking, i.e., m_K/m_π and f_K/f_π. That is, we find $f_K/f_\pi f_+(0) = 1.34$. With the physical value of $f_\pi (= 0.095$ GeV), and with one free parameter, m_σ(tree), we achieve qualitative agreement with experiment for the S-wave nonexotic phase shifts, and the P- and D-wave octet central masses. The exotic S-wave phase shifts are too strongly repulsive and a SU_3 27 representation of states occurs in the D wave. SU_3 is a good symmetry for the P- and D-wave states in spite of large differences in the thresholds of channels generating them. The magnitude of splitting is quantitatively correct. (auth)

24067 WHAT IS THE SPIN OF THE PION. Perkins, W. A. (Univ. of California, Berkeley). Rev. Mex. Fis.; 23: No. 3, 273-299(Sep 1974).

Although it is generally believed that the pion is a spin-zero particle and therefore spherically symmetric, there is a group of experiments which strongly indicate that the distribution of muons from π-μ decay at rest is not isotropic. The spin-zero assignment for the charged pion is based on interpretation of another group of experiments. An attempt was made to resolve this paradox by forming a model of the pion which can satisfy both groups of experiments. The model consists of a composite pion formed of two massless spin-$\frac{1}{2}$ particles. This composite pion is a vector particle and like the photon it does not exist in all three m_S states; this compoite pion exists only in the $m_S = 0$ state. This crude model satisfies the results of both groups of experiments, but is deficient in that oly a massless pion was constructed so far. However, the model does predict experimental results which could prove conclusively that the pion has spin. The argument showing that the neutral pion has zero spin is re-examined, and it is shown that a different assumption regarding the statistics of the photon could allow the π^0 to be a vector particle that decays into two photons. (auth)

24068 SINGLE SOFT-PION EMISSION IN PROTON-ANTIPROTON ANNIHILATION. Intemann, G. W.; Greenhut, G. K. (Seton Hall Univ., South Orange, NJ). Phys. Rev., D; 10: No. 11, 3653-3662(1 Dec 1974).

A soft-pion study using the partially conserved axial-vector current (PCAC) hypothesis is made of four proton-antiproton annihilation processes, $\bar{p}p \to K^+K^-\pi^0$, $\bar{p}p \to K^0\bar{K}^0\pi^0$, $\bar{p}p \to K^-K^0\pi^+$, and $pp \to K^+\bar{K}^0\pi^-$. Using only the assumption of PCAC a soft-pion theorem is derived for neutral-pion emission which leads to a prediction of the cross-section ratios $\sigma(\bar{p}p \to K^+K^-\pi^0)/\sigma(\bar{p}p \to K^+K^-)$ and $\sigma(\bar{p}p \to K^0\bar{K}^0\pi^0)/\sigma(pp \to K^0\bar{K}^0)$ for annihilation at vanishing lab momentum. These predictions are then extended, using the "gentleness" assumption of PCAC, to nonzero lab momentum and directly compared with the available experimental data. A similar analysis is made for charged-pion emission resulting in a prediction of the branching ratios $\sigma(\bar{p}p \to K^-K^0\pi^+)/\sigma(\bar{p}p \to K^-K^0)$ and $\sigma(\bar{p}p \to K^+\bar{K}^0\pi^-)/\sigma(\bar{p}p \to K^+\bar{K}^0)$ for annihilation both at rest and at nonvanishing lab momentum. A direct comparison with existing experimental data is accomplished by making the assumption that the $I = 0$ and 1 s-channel $\bar{N}N$ annihilation amplitudes are comparable. (auth)

24069 ELECTROMAGNETIC FORM FACTORS AND k-π SCATTERING. Curry, P. H. Toronto; Univ. of Toronto (1971). 108p.

Thesis.

The theoretical aspects of pion and nucleon form factors are discussed. A phenomenological model is developed and found to be consistent with $F_1^V = F_\pi$. Describes a model proposed by J. W. Moffat for k-π and π-π scattering. This model is shown to satisfy the postulates of S-matrix theory, except for unitarity and is found to be in reasonable agreement with experiment. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 24539.

24070 (CONF-730580-, pp 57-68) DIFFRACTION DISSOCIATION IN $K^-p \rightarrow K^-p\pi^+\pi^-$. Strauss, J. (Institut fuer Hochenergiephysik, Vienna). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

Using bubble chamber data for incident K^- momenta of 6 to 16 GeV/c, the lower mass bins of the $(K^-\pi^+\pi^-)$ and $(p\pi^+\pi^-)$ systems were fitted with the expression $\sigma \propto p_{lab}^{n}$. It is concluded that the low mass $(K^-\pi^+\pi^-)$ and $(K^+\pi^+\pi^-)$ systems may be produced by a similar mechanism, e.g. diffraction dissociation and they resemble elastic scattering. A D-moment analysis is performed for the $(K^-\pi^+\pi^-)$ system. The effective mass distributions are also shown. (JFP)

24071 (RLO-2041-113) BOUNDS AND THRESHOLD CONSTRAINTS FOR NUCLEON STRUCTURE FUNCTIONS AND THE LIGHT CONE ALGEBRA. Razmi, M. S. K. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Contract AT(45-1)-2230. 15p. Dep. NTIS $4.00.

Bounds on the ratios of the nucleon structure functions are examined using the light cone algebra of Fritzsch and Gell-Mann. It is found that (i) the ratio $(F_2^{en}/F_2^{ep}) \leq 1$; (ii) $0 \leq R_2 = F_2^{\nu p}/F_2^{\nu n} \leq 1$, $0 \leq R_3 = F_3^{\nu p}/F_3^{\nu n} \leq 1$; (iii) at threshold, $R_2 = R_3 = 0$, $R = (F_2^{\nu p} + F_2^{\nu n})/(F_2^{ep} + F_2^{en}) = 18/5$ and $F_2 = 2F_1 = |F_3|$. (auth)

24072 INCLUSIVE $\pi^-p \rightarrow \gamma$ + ANYTHING AND $\pi^{-12}C \rightarrow \gamma$ + ANYTHING REACTIONS AT 40 GeV/c. Balea, O.; Boldea, V.; Felea, S.; Ponta, T.; Gemesy, T.; Hajdu, K.; Jenik, L.; Kiss, D.; Krasznovsky, S.; Pinter, G. Nucl. Phys., B; 83: No. 3, 365-376 (25 Dec 1974).

Some results on inclusive γ and π^0 spectra in π^-p and $\pi^{-12}C$ interactions at 40 GeV/c are reported. It is shown that there is no factorization of the structure function $f(q_\perp, x)$ in $\pi^-p \rightarrow \gamma$ + anything reactions for $q_\perp \leq 0.4$ GeV/c and $|x| \leq 0.16$. The π^0 meson longitudinal momentum spectrum in the cms is obtained by applying the method of statistical regularization to the measured γ spectrum. In the range $|x| \leq 0.02$, $N_{\pi^+} = N_{\pi^-} = N^0$ within the error limits (±7%). The inclusive γ spectra in π^-p and $\pi^{-12}C$ interactions indicate that the normalized structure function is the same for both reactions over the central and the π^- meson fragmentation regions. (auth)

24073 AMPLITUDE ANALYSIS AND GEOMETRICAL PICTURE FOR Δ PRODUCTION PROCESSES. Girardi, G.; Navelet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., B; 83: No. 3, 377-395(25 Dec 1974).

A complete amplitude analysis is performed to obtain the double flip ρ and A_2 contributions. As suggested by the geometrical picture the non-flip and the flip amplitudes are assumed to be identical to the ones already determined from πN and KN reactions up to t-independent real constants. Evidence for the validity of this assumption is given; SU(3) prediction works quite well with the experimental data on $KN \rightarrow K\Delta$ processes. (auth)

24074 THE EVEN SIGNATURED, ISOSCALAR EXCHANGE AMPLITUDES AT 6 GeV/c. Girardi, G.; Navelet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service de Physique Theorique); Godreche, C. (Paris-7 Univ., 75 (France)). Nucl. Phys., B; 83: No. 3, 515-524(25 Dec 1974).

An analysis of experimental data on KN elastic reactions and regeneration experiments leads to the $I_t = 0$ even signatured amplitudes. The results are similar to those obtained through amplitude analysis of πN scattering. Spin conservation seems to be favored rather than helicity conservation. Predictions of the spin rotation parameters R^t and of the polarization for the regeneration experiment are given. (auth)

24075 OFF-ENERGY-SHELL CONTINUATION OF THE πN TRANSITION MATRIX ELEMENT. Nakano, K. (Victoria Univ., British Columbia (Canada). Dept. of Physics). Nucl. Phys., A; 235: No. 2, 486-498(16 Dec 1974).

General relationships of the fully off-shell T-matrix element for central forces are derived. The problem of finding the fully off-shell T-matrix element can be reduced to finding a real two-parameter function $\phi(p,k)$. It can be shown in the case of no bound state that, if $\phi(p,k)$ is separable, the whole problem becomes equivalent to the inverse scattering problem. An approximate method to include inelastic effects is proposed, and the πN off-shell T-matrix element is calculated. (auth)

24076 THE POMERON IN ELASTIC MESON-BARYON SCATTERING. Collins, P. D. B.; Gault, F. D.; Martin, A. (Durham Univ. (UK)). Nucl. Phys., B; 83: No. 2, 241-252(18 Dec 1974).

It is shown that a pomeron (P) trajectory with $\alpha p(t) \sim 1.07 + 0.22t$ provides a simple and satisfactory fit to $\pi^\pm p$ and $K^\pm p$ elastic scattering data (as well as pp and $\bar{p}p$ considered in an earlier publication) for $|t| < 1.2$ GeV^2, including the rising total cross sections. The destructive term needed to explain the diffraction minimum in pp may be explained as a weak P⊗P cut effect provided that the Gribov vertices are given suitable structure, and the prediction is then made that similar minima should be observed in meson-baryon scattering at FNAL somewhere in the region $1.5 < |t| < 2.5$ GeV^2. The P⊗P cut does not seem to be related (at least directly) to the unitarization effects which must eventually make $\sigma_{tot} \sim \log^2 s$ (but not until $s > 10^8$ GeV^2). Thus the "effective" J-plane singularity structure, at currently available energies seems to be much simpler than it can be asymptotically. (auth)

24077 TENSOR EXCHANGE IN MESON–BARYON SCATTERING. Elvekjaer, F.; Johnson, R. C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 83: No. 1, 142-167(11 Dec 1974).

Amplitudes for A_2 quantum number exchange in $K^\pm N$ scattering are determined at $p_L = 3$, 4 and 6 GeV using new $K^\pm N$ CEX differential cross-section data supplemented by sum rule estimates of polarizations. Amplitudes for ρ quantum number exchange are calculated from πN scattering by SU(3) octet symmetry. This is justified by $K^\pm N$ FESR, which furthermore are used to resolve ambiguities in the analysis. Comparison with other reactions involving charge and hypercharge exchange shows reasonable overall consistency between data, SU(3), and the tensor amplitudes. The phase of the A_2 s-channel helicity flip amplitude is well described by a Regge pole term with trajectory displaced downwards relative to that appropriate for the ρ flip amplitude. This is shown to be the main mechanism contributing to the difference between differential cross sections for the $K^\pm N$ CEX processes, connected by line reversal. It is suggested that this mechanism may persist at higher energies. The A_2 nonflip amplitude does not have the standard peripheral form. (auth)

24078 POLARIZATION SUM RULES. Elvekjaer, F.; Johnson, R. C. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 83: No. 1, 127-141(11 Dec 1974).

Sum rules for observable combinations of amplitudes in $0^-{}^1/_2^+$ scattering are derived, discussed, and tested, leading to estimates of polarization parameters P, R, A at intermediate energies. Predictions are given for πN, KN and $\bar{K}N$ processes, and tests of phase-shift solutions are discussed. (auth)

24079 ONE-PION EXCHANGE MODEL IN THE VECTOR THEORY FOR THE REACTION $\pi N \rightarrow \rho N$. The Present Status: Connection with the Absorption. Achasov, N. N.; Shestakov, G. N. (Inst. of Mathematics, Novosibirsk, USSR). Fortschr. Phys.; 22: No. 1-2, 35-52(1974).

It is shown that the Born diagram model with an overall phenomenological form factor suggested previously on the basis of the ideas of universal interaction of ρ-meson with hadrons describes well the experimental data on the reaction $\pi^-p \rightarrow \rho^0 n$ in a wide range of energies 2.7 GeV/c $\leq q_L \leq$ 17 GeV/c at small momentum transfers $|t| \leq 0.2$ (GeV/c)^2. The connection of the Born diagram model with the other high energy models is considered. On one hand, it is shown that the absorption account in many respects, though not literally, comes to forming an overall form factor. On the other hand, the normalization of amplitudes of the traditional absorptive one-pion exchange models to the Born diagrams at $t = 0$ lays on the absorptive parameters the condition $\sigma_{tot}C/8\pi A = 1$ corresponding to the total absorption of the low partial waves. In this case the one-pion exchange models with absorption coincide at all t with the Born diagram model with absorption and the reaction amplitudes are independent of a choice of the initial vector theory Lagrangian. (auth)

24080 DYNAMIC MODEL OF AMPLITUDE WITH SPIN FLIP. Levintov, I.I. (Institute of Theoretical and Experimental Physics). JETP Lett. 20: No. 4, 125-126 (20 Aug 1974).

The parameter R in π^-p scattering at 40 GeV/c is calculated on the basis of a model in which a polarized proton is regarded as a "rotating" particle. The sign of the asymmetry is predicted for the π (p, n)2π reaction on polarized protons. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 24111.

24081 (CEA-N-1720) PROTON–PROTON PHASE SHIFT ANALYSES BETWEEN 510 AND 735 MeV. Cozzika, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. de la Physique). Jul 1974. 128p. (In French). Dep. NTIS (US Sales Only) $9.50.

Thesis. Submitted to Paris Univ., Orsay, France.

Phase shift analyses were done at 510, 600, 635, 680 and 735 MeV using existing data at each energy. These analyses were done with $L_{max} = 5$, the contribution of higher partial waves being

given by the OPE model. The data are not sufficiently well determined to allow complete specification neither of the $^3P_0$ real phase shift nor of the $^3P_0$ and $^3P_1$ inelasticity parameters. For the other waves an unique solution was found except at 735 MeV where the lack of data leads to several ambiguities. There is no evidence in this energy region of a dibaryonic resonance in the $^1D_2$ phase, and the observed structure can be well explained by the presence of the inelastic channels. (auth)

24082 (IC-73-149) NON-LOCAL SEPARABLE POTENTIAL AND p^-p SCATTERING. Ali, S.; Rahman, M.; Husain, D. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1973. 4p. INIS.

An analysis of S-wave p^-p scattering for the energy range of 0-400 MeV (Lab) is presented using a Mongan-type interaction. Coulomb effects have been included exactly. (tr-auth)

24083 (IFVE-STF-73-105) GROWING TOTAL CROSS SECTIONS AND ELASTIC SCATTERING. Solov'ev, L. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 8p. INIS.

A simple expression was proposed for the amplitudes of the elastic proton-proton scattering corresponding to the Froissart growth of the total cross section and satisfactorily describing all data on the differential cross sections obtained on the CERN storage ring. (tr-auth)

24084 (JINR-1-7671) THRIFT AND LINEX PROGRAMS FOR THE PROCESSING OF p^+p^- AND p^+p^- INCLUSIVE REACTIONS ON BESM-6 COMPUTER. Rud, V. I.; Tikhonova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). INIS.

A system is described for handling inclusive reactions in pp- and $\bar{p}p$-interactions which were investigated on materials of the unit "Lyudmila." The results of the geometric program THRESH are taken as the starting material. A detailed description is given for the program of obtaining a tape of the additive results -LINEX and of linking the results of two measurements of a single event -THRIFT. (tr-SJR)

24085 (LBL-3362) HIGH ENERGY HEAVY ION COLLISIONS: A POSSIBLE TESTING GROUND FOR HIGH ENERGY INTERACTION MODELS. Schroeder, L. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 25p. (CONF-740933-4). Dep. NTIS $4.25.

From Meeting of the Division of Particles and Fields of the American Physical Society; Williamsburg, Virginia, USA (5 Sep 1974).

A review of existing data on nucleus–nucleus collisions at Bevatron–Bevalac energies (few GeV/nucleon) is given to test to what extent such collisions can be compared to nucleon–nucleon studies performed at NAL and ISR energies. Data are examined for such phenomena, as limiting fragmentation, scaling, and factorization of cross sections. A brief discussion of experiments—either in progress or about to start—which bear on the question of testing high-energy interaction models is included. (auth)

24086 SHORT-RANGE CORRELATIONS IN HIGH-ENERGY HADRON COLLISIONS. Guardiola, R.; Oset, E. (Barcelona Univ. (Spain). Departamento de Fisica Teorica). Nucl. Phys., A; 234: No. 2, 458-468(2 Dec 1974).

High energy collisions of hadrons on nuclei are studied by means of Glauber multiple scattering theory, using Jastrow correlated wave functions. To this end a cluster expansion is derived, and its convergence properties are studied. Calculations were carried out for ^{4}He and ^{16}O nuclei, and they are compared with experimental data. (auth)

24087 THE FORMATION OF HYPERNUCLEI BY K^- CAPTURE. Huefner, J.; Lee, S. Y.; Weidenmueller, H. A. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 234: No. 2, 429-444(2 Dec 1974).

K^- capture leading to the formation of hypernuclei takes place with the kaon either in a Bohr orbit (capture at rest), or in flight. Both situations are analyzed in the framework of the distorted-wave impulse approximation (DWIA), cross sections and formation rates are derived and the results compared with experimental data on the reaction $^{12}C(K^-, \pi^-)^{12}{}_{\Lambda}C^*$. Corrections to the DWIA which arise from rescattering from binding energy effects and from the intermediate formation of a Σ-hyperon, are estimated and found not to be negligible. (auth)

24088 THE NON-MESONIC TO π^- MESONIC DECAY RATIO AND Λ^- NEUTRON STIMULATION FRACTION FOR P-SHELL HYPERNUCLEI. Montwill, A.; Moriarty, P. (University Coll., Dublin (Ireland). Dept. of Physics); Davis, D. H. (University Coll., London (UK)); Pniewski, T.; Sobczak, T. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Adamovic, O. (Institut za Fiziku, Belgrade (Yugoslavia)); Krecker, U. (Akademie der Wissenschaften der DDR, Berlin); Coremans-Bertrand, G.; Sacton, J. (Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). Nucl. Phys., A; 234: No. 2, 413-428(2 Dec 1974).

Kinematic analysis of simple hypernuclear production reactions has produced a sample of hypernuclei of $_{\Lambda}B$, $_{\Lambda}C$ and $_{\Lambda}N$ with negligible background, and a much smaller sample of $_{\Lambda}Be$. The values of the nonmesonic to π^- mesonic ratio Q^- for the above samples are 5.5 ± 0.5 and 4.3 ± 1.1, respectively. A sub-sample of $^{11}_{\Lambda}B$ hypernuclei was separated on the basis of production via an excited state of $^{12}_{\Lambda}C$, giving $Q^- = 4.8 \pm 1.1$ for $^{11}_{\Lambda}B$. Assuming the Fermi gas model is applicable to nuclei of mass $A \sim 11$, two independent means of analysis of the nonmesonic decays give values for the Λ-neutron stimulation fraction n of 0.41 ± 0.09 and 0.34 ± 0.07 for hypernuclei of charge $5 \leq Z \leq 7$. (auth)

24089 THE CHARGE-SYMMETRY BREAKING NN INTERACTION. Riska, D. O.; Chu, Y. H. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 235: No. 2, 499-519(16 Dec 1974).

The charge-symmetry-breaking nucleon–nucleon potential due to the $\pi^0\gamma$ exchange mechanism and that due to the np mass difference in the two-pion exchange mechanism are derived from the field-theoretical amplitudes. The resulting potential is such as to make the pp interaction more attractive than the nn interaction. (auth)

24090 LEPTON PAIR PRODUCTION BY HADRONIC COLLISIONS IN THE REGGE LIMIT. Galfi, L. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary)); Koegerler, R. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Nucl. Phys., B; 82: No. 3, 527-548(4 Dec 1974).

A refined and corrected version is presented of the Regge analysis of inelastic muon pair production by proton-proton collision. The role of the different high energy limits (fragmentation, pionization) is studied in full detail, both for the amplitude and for the structure functions. The possibility of Bjorken-scaling is discussed. A very simple physical interpretation of the results of the BNL-Columbia experiment can be given. (auth)

24091 THE USE OF FIXED T ANALYTICITY IN ELASTIC PROTON-PROTON SCATTERING. Kroll, P. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 82: No. 3, 510-526(4 Dec 1974).

Several methods of exploiting fixed-t analyticity are described and compared with each other. For the forward amplitude the predictions of the real parts from the total cross section data—including the new NAL data—and dispersion relations are found to be in good agreement with the Coulomb interference data. It is also discussed how the results depend on the assumptions on the asymptotic behavior of the cross section. Furthermore, the conventional dispersion relation approach is compared with the method of analytic parametrization and with the differential operator method. For the nonforward directions, information on the amplitude is extracted from a dispersion relation for the slopes and from a relation between the phase and the modulus of the amplitude. (auth)

24092 DIRECT EVIDENCE FOR INDEPENDENT EMISSION OF CLUSTERS. Quigg, C. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Pirilä, P.; Thomas, G.H. Phys. Rev. Lett. 34: No. 5, 290-293 (3 Feb 1975).

In the distribution of rapidity gaps between charged particles produced at 100–400 GeV/c, we find direct evidence for the independent production of clusters with density approximately one per unit of rapidity. This cluster–density measurement and the observed charged–particle density imply that the mean number of charged particles per cluster is about two. Implications of these numbers and techniques for refining them are discussed. (auth)

24093 ESTIMATE OF THE LOWER BOUND OF THE CROSS SECTION FOR THE PRODUCTION OF SUPERCHARGED HADRONS IN STRONG INTERACTIONS. Konoplich, R.V.; Nikolaev, N.N. (L. D. Landau Institute of Theoretical Physics, USSR Academy of Sciences). JETP Lett. 20: No. 6, 192-193 (20 Sept 1974).

A relation between the lower bound of the cross section for the production of pairs of heavy particles and the cross section for the production of heavy muon pairs is obtained within the framework of the parton model. A scaling law is obtained for the lower bound of the cross section, $\sigma(h_1h_2 \to R_1R_2+X) = \sigma_0(M_p/M)^2 f(M^2S)$. It is shown that in the parton model the growth of the total cross section of PP scattering at NAL or ISR energies can be attributed to a threshold effect in the production of $N\bar{N}$ pairs. (auth)

Particle Invariance Principles and Symmetries

Refer also to abstract 23572.

24094 EXPLICIT SPONTANEOUS BREAKDOWN IN A DUAL MODEL. Bardakci, K.; Halpern, M.B. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. D 10: No. 12, 4230-4246 (15 Dec 1974).

We formulate and solve an integral-equation approach to spontaneous breakdown in a certain dual model. The model is not yet physical, but Goldstone and Higgs phenomena are visible in the explicit spectrum shift which removes the (tachyonic) vacuum instability. (auth)

General

Refer also to abstracts 24509, 24528, and 24548.

24095 NON-TRIVIAL ZEROS OF THE RACAH (6-j) COEFFICIENT. Koozekanani, S. H. (Ohio State Univ., Columbus); Biedenharn, L. C. Rev. Mex. Fis.; 23: No. 3, 327-340(Sep 1974).

The nontrivial zeros of the (6-j) symbol are tabulated for arguments $\leq 37/2$. The significance of nontrivial zeros is discussed. (auth)

24096 ON THE CONTINUITY OF THE BOOSTS FOR EACH ORBIT. Boya, L. J.; Carinena, J. F.; Santander, M. (Valladolid Univ. (Spain). Dept. of Theoretical Physics). Commun. Math. Phys.; 37: No. 4, 331-334(Sep 1974).

The possibility of a continuous choice of the boost for each orbit is studied by making use of mathematics of fibre bundles, and it is shown that this choice is possible only for massive particles. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 24040 and 24307.

24097 GAUGE INVARIANCE OF THE SCALAR-VECTOR MASS RATIO IN THE COLEMAN-WEINBERG MODEL. Kang, J.S. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev. D 10: No. 10, 3455-3467 (15 Nov 1974).

The scalar-meson to vector-meson mass ratio, due to spontaneous symmetry breakdown, is calculated in the two-loop approximation of massless scalar quantum electrodynamics. Although the effective potential is gauge-dependent, this mass ratio is found to be gauge-independent. This strongly supports the interpretation given by Coleman and Weinberg that the radiative corrections drive the spontaneous symmetry breakdown in this theory. The mass ratio is found to be $m_s^2/m_v^2 = (3/2)e^2/4\pi^2 - (61/48)(e^2/4\pi^2)^2$, where e^2 is the physical coupling constant. (auth)

24098 SPINLESS-MESON MASSES IN A UNIFIED GAUGE THEORY. Datta, A.; Ghose, P. (Department of Physics, Visva-Bharati University, Santiniketan-731235, West Bengal, India). Phys. Rev. D 10: No. 10, 3476-3479 (15 Nov 1974).

An estimate (in the one-loop approximation) of the mass of a Bardakci-Halpern exotic ($C = -1$) isosinglet, spinless meson (P_0) has been made in a fully massless hadronic gauge theory by applying the methods of Coleman and Weinberg. (auth)

24099 COMPOSITE HIGGS FIELDS AND FINITE SYMMETRY BREAKING IN GAUGE THEORIES. Goldman, T.; Vinciarelli, P. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 10: No. 10, 3431-3434 (15 Nov 1974).

Gauge models in which the symmetry breaking is dynamical, realized by certain composite Higgs fields acquiring a vacuum expectation value, are more constrained than corresponding models in which the symmetry breaking is implemented by auxiliary elementary scalar representations present at the Lagrangian level. In the former case, physical quantities which would otherwise be free parameters become computable. We illustrate this notable fact for the interesting case of the electron-muon mass ratio in Weinberg's chiral SU(3) model. (auth)

24100 POSSIBLE TESTS FOR *CP* NONINVARIANCE INVOLVING *J* PARTICLES. Barshay, S. (Physics Department, State University of New York, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 6, 345-347 (10 Feb 1975).

If, in collisions of hadrons, the newly discovered J^0 particle turns out to be produced in association with its antiparticle $\bar{J}^0$ with conservation of an additive quantum number, then the decays of the J^0-$\bar{J}^0$ systems produced in hadron collisions and in e^+e^- colliding beams provide new possibilities for studying the nature and the strength of *CP*-invariance-violating interactions. (auth)

Applications (Strong)

Refer also to abstracts 24184 and 24551.

24101 GROUP THEORETICAL STRUCTURE OF HADRON MASS SPECTRA IN SU(2) × SU(2) DYNAMICS. Noga, M.; Nagy, P. (Komensky Univ., Bratislava). Acta Phys. Slovaca; 23: No. 3, 158-167(1973).

The Weinberg algebraic realization of the chiral SU(2) ⊗ SU(2) symmetry is considered for a case when only s-wave and p-wave pions are taken into account. Under the generally accepted assumption of the absence of exotic states, the mass spectrum operator of hadrons is proved to behave as a sum of scalar and a component of a 35-dimensional totally antisymmetric third-rank tensor of the group SO(7). (Nucl. Sci. Abstr. Czech.)

24102 QUARK CONFINEMENT AND THE PUZZLE OF THE NINTH AXIAL-VECTOR CURRENT. Kogut, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850); Susskind, L. Phys. Rev. D 10: No. 10, 3468-3475 (15 Nov 1974).

A solution to the U(3) × U(3) problem—the absence of a ninth pseudoscalar Goldstone boson—is proposed. The mechanism for eliminating the unwanted Goldstone boson involves the same infrared instabilities of Yang-Mills theory which confine quarks and eliminate physical "color" states. A formal argument is presented, and two models of quark confinement illustrate the mechanism involved in eliminating the spurious massless state. (auth)

24103 PSEUDO-GOLDSTONE PIONS IN SU_3 MODELS. Danskin, H. (Physics Department, Imperial College, London SW7, England). Phys. Rev. D 10: No. 10, 3501-3508 (15 Nov 1974).

Motivated by the masslessness of the pseudoscalar nonet in the U_3 generalization of the Bars-Lane model, we develop general principles for pseudo-Goldstone-Boson models of this type, and show (i) that the Bars-Lane model is indeed the most economical that can be constructed and (ii) that the unlocking problem for models involving SU_3 or higher groups is quite general, and unavoidable. As for the mysterious disappearance of the pion mass, we show by one-loop calculation that the mass becomes nonzero, irrespective of the gauge coupling, i.e., that there is no higher symmetry, and also indicate a quick method of determining which fields will be massless in lowest order. A serious problem arises when the η and X^0 are shown to remain massless with the π, while the K acquires a mass, once the vacuum symmetry is broken to $SU_2 \otimes U_1$; although it is possible to generate a mass for the X^0, it appears very unlikely that the $\eta-\pi$ degeneracy in lowest order can be removed in a realistic model based on these lines. (auth)

24104 SU(4) SYMMETRY AND THE POSSIBLE EXISTENCE OF NEW HADRONS. Okubo, S.; Mathur, V.S.; Borchardt, S. (University of Rochester, Rochester, New York 14627). Phys. Rev. Lett. 34: No. 4, 236-239 (27 Jan 1975).

We derive SU(4) mass formulas taking mixing, whenever it arises, fully into account. With the masses of the usual hadrons and that of the newly discovered resonance ψ as input, we predict the masses of the new 1^- and 0^- mesons as well as the $1/2^+$ and $3/2^+$ baryons. (auth)

Scattering Theory

Refer also to abstracts 24503 and 24511.

24105 (IFVE-STF-73-87) ELASTIC AND INCLUSIVE PROCESSES AT INCREASING TOTAL CROSS SECTION. Anisovich, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 11p. INIS.

The interactions which lead to logarithmic growth of the total cross section were examined. For these interactions the elastic scattering amplitude properties of the inclusive cross sections in the central region and the fragmentation region were discussed. (tr-auth)

24106 OPERATOR FORMULATION OF REGGE ASYMPTOTIC BEHAVIOR. Brandt, R. A. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 83: No. 1, 60-92(11 Dec 1974).

If the appropriate high energy limits of the amplitudes $W \equiv \int dx\, e^{iq\cdot x} \langle b|j(x)j'(0)|b'\rangle$ are Regge pole dominated, then the large distance ($x_0 \to \infty$, x^2 fixed) behavior of the current product is completely characterized by an operator expression $\mathcal{R}(x:0)$, involving only local operators at 0, which is such that $R \equiv \int dx\, e^{iq\cdot x} \langle b|\mathcal{R}|b'\rangle$ and W have the same high energy behavior. In the only case ($|b\rangle$ a single particle state and $|b'\rangle$ the vacuum) where W is not Regge behaved, it is shown that R is identical to W, and so the relation $jj \to \mathcal{R}$ is established as a large distance operator expansion, valid between all states. $\mathcal{R}$ is expressed as a differential operation $B(\Box_x, \partial_x \cdot \partial_0, \Box_0)$ on the light-cone expansion and some of

its properties are deduced by carrying out the differentiations. A second form of $\mathcal{R}$ is given in terms of nonlocal "reggeon" field operators $R_{\alpha m}(0)$ (α is a (fixed) spin index and m is a (variable) helicity index) which might be useful coordinates in reggeon field theories. These operators can be used to define reggeon-particle amplitudes and if conventional double-Regge and triple-Regge behaviors are further assumed, the large distance behaviors of the current-reggeon and reggeon-reggeon field products are specified in terms of other reggeon fields. (auth)

24107 HIGH ENERGY FIXED ANGLE SCATTERING IN A FIELD THEORY MODEL. Halliday, I. G.; Huskins, J.; Sachrajda, C. T. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Phys., B; 83: No. 2, 189-217(18 Dec 1974).

Massive electrodynamics is treated as a model for fixed angle scattering. The dominant momentum flow through Feynman diagrams at high energies is examined. In spinor electrodynamics this leads to the "eikonal" answer. In scalar electrodynamics other flows which cancel between different diagrams must also be considered. The analysis is carried out in Feynman parameter space. As well as the d-line contributions the pinch effects are also analyzed. Although for a given diagram these may be larger they again cancel between diagrams. To leading powers of log s, the "eikonal" answer is thus proved for spinor and scalar electrodynamics. (auth)

24108 SCATTERING BY SINGULAR POTENTIALS. Baeteman, M. L. (Brussels Univ. (Belgium)). Nucl. Phys., A; 235: No. 1, 249-266(9 Dec 1974).

This paper concerns the problem of calculating phase shifts for non-relativistic scattering by singular potentials. First, a general and exact formula for the phase shifts in the case of repulsive singular potentials is derived. As an application of this formula, the low- and high-energy behaviors of the phase shifts for potentials of the type $V(r) = g^2 r^{-n}$, $n > 2$ are studied. Turning then to the case of attractive potentials a proposal for considering these potentials as the limit of complex potentials is studied. It is shown that it is a perfectly acceptable definition for regular potentials and that it gives a unique prescription to calculate scattering in the case of singular potentials. Finally, it is shown that the practical computation of the phase shift can be achieved numerically starting with the formal Thomé solution of the radial Schrödinger equation and using Padé approximants as an improvement tool for this solution. (auth)

24109 ON THE TWO-POMERON CUT IN THE PARTICLE-POMERON AND POMERON-POMERON AMPLITUDES. Sachrajda, C. T. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Phys., B; 83: No. 2, 321-332(18 Dec 1974).

The sign of the two-pomeron cut is examined in the pomeron-production and pomeron scattering amplitudes in a weak coupling $\lambda\phi^3$ perturbation theory model and also in a reggeon calculus model. These amplitudes can be related to the one- and two-particle inclusive cross sections in the appropriate regions of phase space, and if the triple-pomeron coupling vanishes sufficiently quickly with t (a linear relation is sufficient) then there is a region where these cuts dominate the inclusive cross sections. This would seem to indicate that these cuts are positive at $t = 0$, in contrast to the negative sign of the two-pomeron cut in the particle-particle amplitude found previously in the same models. It is found that in the $\lambda\phi^3$ model the cuts are in fact negative whereas in reggeon calculus model their sign is in general undetermined. However if a nonanalytic correction term is added to the usual linear form for the triple-pomeron coupling, it is found that the contribution to the inclusive cross section from the triple-pomeron diagram does not vanish at $t = 0$, and yet is consistent. (auth)

24110 SUMMATION OF PARTIAL WAVES FOR LARGE-ANGLE SCATTERING. Razavy, M.; Teshima, R. (Alberta Univ., Edmonton (Canada). Theoretical Physics Inst.). Nucl. Phys., A; 235: No. 2, 278-288(16 Dec 1974).

For large-angle elastic scattering different methods of summing partial wave amplitudes are investigated for their accuracy and simplicity of computation. It is found that among the approximations considered, the method of expanding the T-matrix in terms of the weighted orthogonal polynomials proposed by Brysk is the most accurate way of calculating the scattering amplitude in the backward direction. If the two-particle interaction is assumed to be a Yukawa potential, then the lth partial sum of the T-matrix with the weighted polynomials can be expressed as the lth partial sum with the Legendre polynomials and a correction term which depends on the phase shift for the lth partial wave. (auth)

24111 METHOD FOR LIPPMANN–SCHWINGER EQUATIONS. Sloan, I. H.; Adhikari, S. K. (New South Wales Univ., Kensington (Australia)). Nucl. Phys., A; 235: No. 2, 352-360(16 Dec 1974).

A recently proposed degenerate-kernel scheme for solving Fredholm integral equations of the second kind is extended to singular equations of the Lippmann–Schwinger type. Numerical calculations of on- and off-shell t-matrix elements are carried out at positive and negative energies for the $^1S_0$ Reid soft-core nucleon–nucleon potential. Satisfactory convergence is achieved, even with the simplest version of the scheme. (auth)

24112 REMARK ON UNITARITY BOUNDS FOR ELASTIC-SCATTERING AMPLITUDES. Schwarz, F. (Univ., Kaiserslautern, Ger.). Lett. Nuovo Cim.; 12: No. 3, 65-68(18 Jan 1975).

The question of deriving bounds for the real part of the elastic scattering amplitude if only unitarity is assumed is considered. It is examined under what conditions a finite bound exists. (JFP)

24113 MULTIPARTICLE SCATTERING AMPLITUDES WITH SPIN–INDEPENDENT POINCARÉ–TRANSFORMATION PROPERTIES. Tindle, G.L. (Department of Physics, Queen Mary College, University of London, Mile End Road, London E.1, England). Phys. Rev. D 10: No. 10, 3480-3494 (15 Nov 1974).

For systems of massive particles with arbitrary spins, we define new classes of invariant scattering amplitudes. No auxiliary spin group is used, and the amplitudes are parametrized by the eigenvalues of Poincaré–invariant operator–valued functions of single–particle observables alone. We construct frame–independent partial–wave decomposition formulas for these amplitudes, and give a detailed derivation of the constraint equations which they must satisfy if scattering processes are to be invariant under space–time translations and proper homogeneous Lorentz transformations. In appendixes we collect together the definitions and transformation properties of many multiparticle states and scattering amplitudes, and derive some useful kinematical transformation formulas. (auth)

24114 OPERATOR FORMULATION OF THE MULTI–REGGE–POLE HYPOTHESIS. Brandt, R.A. (Department of Physics, New York University, New York, New York 10003). Phys. Rev. D 10: No. 10, 3509-3519 (15 Nov 1974).

The conventional multi–Regge–pole behaviors of all many–body scattering are shown to be consequences of two assumptions: (i) the validity of large–distance operator–product expansions (LDOPE's) in a strong sense for all local field products, and (ii) the validity of the conventional single–Regge–pole behavior for all 2–to–2 amplitudes. The LDOPE's (as weak limits) were previously deduced from the assumption of single–Regge–pole dominance of many–body amplitudes in the appropriate high–energy limits, but are here abstracted (as strong limits) to form the basis of an operator formulation of the multi–Regge hypothesis. This hypothesis was previously based on O(3) or O(2,1) expansions and strong but unproven analyticity and boundedness assumptions. The proposed operator framework avoids such assumptions and proceeds by repeatedly using the LDOPE's to reduce a multiparticle amplitude to a sum over 2–to–2 amplitudes. In this way, the correct multi–Regge behavior with 2–body Regge trajectories is obtained. Furthermore, the deduced Reggeon–particle vertices are expressed in terms of particle matrix elements of operator structures and simpler vertices. This leads to consistency conditions and restrictions on the vertices, and further restrictions can be obtained by performing the above reductions in different ways. (auth)

24115 MODIFIED WKB APPROXIMATION FOR PHASE SHIFTS OF AN ATTRACTIVE SINGULAR POTENTIAL. Wald, S.S.; Lu, P. (Department of Physics, Arizona State University, Tempe, Arizona 85281). Phys. Rev. D 10: No. 10, 3434-3440 (15 Nov 1974).

The conventional WKB method for phase–shift calculations is known to fail for singular potentials at low incident energies. The modified WKB method can be applied successfully to singular potentials even at low energies, since it is an extreme generalization of the conventional WKB method. As a special case, the modified WKB method can be reduced to the conventional WKB approximation and then agrees with the conventional WKB method in the high–energy region where the conventional WKB approximation is valid. Unlike the conventional WKB method, the modified WKB method can be applied to multi–turning–point problems without any difficulty. It is for these reasons that we present this method for determining the phase shifts of the attractive singular potential using a potential of the form $U(r) = -g^2 r^{-4}$ as an example. We restrict ourselves to the low–energy, nonzero–orbital–angular–momentum case where there are three classical turning points in order to demonstrate the ability of this method to handle many turning points. The phase shifts obtained by this method agree with the numerical results. (auth)

24116 PHASE SHIFTS AS FUNCTIONS OF THE CROSS SECTION. Atkinson, D.; Kaekebeke, M.; de Roo, M. (Institute for Theoretical Physics, Postbox 800 wsn 4, Groningen, The Netherlands). J. Math. Phys. (N.Y.) 16: No. 3, 685-693 (Mar 1975).

We show that an elastic scattering amplitude may be defined as an implicit function of the differential cross section. A practical method is given for a numerical investigation of this dependence, both in the elastic and in the inelastic regions. In particular, we consider the case of a polynomial amplitude, and we show that the Crichton ambiguity is not isolated. (auth)

24117 GENERAL MANY–CHANNEL VARIATIONAL PRINCIPLES FOR MULTIPARTICLE SCATTERING. Kouri, D.J. (Max–Plack–Institut für Strömungsforschung, 3400 Göttingen, Böttingerstrasse 6–8, Federal Republic of Germany); Levin, F.S. Phys. Rev. C 11: No. 2, 352-359 (Feb 1975).

A general multichannel scattering formalism based on Schwinger–type variational principles and capable of treating rearrangements was recently presented by Tobocman. The approach involved combining variational functionals for individual transition operators with new coupled integral equations for these operators derived recently by Baer and Kouri and by Kouri and Levin. In this paper, we present general variational principles whose Euler equations are precisely the new coupled channel $T_{\alpha\beta}$ operator equations obtained by Kouri and Levin. The results are expressions which are stationary with respect to variations in all the $T_{\alpha\beta}$ simultaneously rather than just for a single $T_{\alpha\beta}$ operator. It is shown that such matrix generalizations may be obtained for a variety of functionals. With the specific choice of a channel permuting array (as discussed by Tobocman and by Kouri and Levin), the present formalism provides a valid computational basis for general many–body (e.g. nuclear) reactions, since then the iterated kernels of the resulting coupling channel $T_{\alpha\beta}$ operator equations are completely connected. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 22518.

24118 NEW FORMS OF STATE EQUATIONS FOR HELIUM. Arp, V. (National Bureau of Standards, Boulder, CO). Cryogenics; 14: No. 11, 593-598(Nov 1974).

Accurate helium properties must be measured to develop refrigeration systems for superconducting motors and generators. Normally when measuring these properties a double iteration is necessary on the equation of state to find density and temperature. New state equations are developed which eliminate iterative procedures. These equations are subsets of three overlapping sets of reference equations. They are thermodynamically inconsistent to the reference equations by a small degree of error, but have been found useful for many calculations. (auth)

24119 EASILY MADE DEMOUNTABLE ELECTRICAL FEEDTHROUGH FOR USE IN SUPERFLUID HELIUM. Butterworth, G. J. (Univ. of Sussex, Eng.). Cryogenics; 15: No. 1, 40(Jan 1975).

Epoxy-metals seals are described here which were developed for use in a cryostat in which it was necessary to pass a wire carrying radio frequency signals from a 30 MHz oscillator immersed in a helium bath into an evacuated chamber. There, in addition to its remaining leak tight, the feedthrough was required to maintain alignment of the central conducting wire while introducing minimal stray capacitance, and also allow easy disassembly. These seals are easily made in any size from readily available materials and have been found to remain leak-tight to superfluid helium following many thermal cycles between room and liquid helium temperatures. Provided they are not overheated they can be unsoldered and reused several times. (UK)

24120 POSSIBLE MODEL STATES FOR THE B PHASE OF SUPERFLUID ^{3}He. Moore, M. A.; Vuorio, M.; Haavasoja, T.; Vidberg, H. G. (Univ. of Helsinki). J. Phys., C (London); 7: No. 23, L418-L422(7 Dec 1974).

Various alternatives to the Balian-Werthamer model of the B phase of superfluid ^{3}He are considered. The linear NMR properties of a certain f-wave state of axial symmetry are shown to be very similar to those required by experiment. (auth)

24121 SUPERFLUIDITY OF ^{3}He IN DILUTE SOLUTIONS OF ^{3}He IN LIQUID ^{4}He. Oestgaard, E. (Univ., Trondheim, Norway). Phys. Lett., 49A: No. 6, 433-434(21 Oct 1974)

The possibility of superfluidity of ^{3}He in dilute solutions of ^{3}He in liquid ^{4}He is investigated, and the corresponding critical temperature is estimated. The results indicate S-state pairing, i.e., for small concentrations of ^{3}He, the highest transition temperature is obtained for L = 0, but the obtained critical temperatures are very low. (auth)

24122 TRANSLATIONAL VELOCITY OF A CLASSICAL VORTEX RING. Fetter, A. L. (Stanford Univ., CA). Phys. Rev., A; 10: No. 5, 1724-1727(Nov 1974).

A straightforward dynamical analysis of the local velocity field around a classical vortex ring yields the well-known translational velocity $(\kappa/4\pi r_0)\,[\ln(8r_0/a) - \frac{1}{2} + \delta]$, where κ is the circulation, r_0 the radius, a the core radius, and $\delta = 0$ or $\frac{1}{4}$ for a hollow core or a core with solid-body rotation, respectively. (auth)

24123 CALCULATION OF THE EXCITATION SPECTRUM OF SUPERFLUID ^{4}He. Goble, G. W. Denton, TX; North Texas State Univ. (1974). 200p. University Microfilms Order No. 75-881.

Thesis (Ph. D.).

The Hartree-Fock-Bogolyubov theory of homogeneous boson systems at finite temperatures is rederived using, a free energy variational principle. It is shown that a t-matrix naturally emerges in the theory. Phenomenological modifications are made (1) to remove the energy gap at zero momentum, and (2) to eliminate the Hartree-Fock-like terms, which dress the kinetic energy of the particle. A numerical calculation of the energy spectrum is made over a temperature range of 0.00 to 3.14 K using the Morse dipole-dipole-2 potential and the Frost-Musulin potential. The energy spectrum of the elementary excitations is calculated self-consistently. It has a phonon behavior at low momentum and a roton behavior at higher momentum, so it is in qualitative agreement with the observed energy spectrum of liquid He II. However, the temperature dependence of the spectrum is incorrectly given. At the observed density of 0.0219 atoms Å^{-3}, the depletion of the zero-momentum state at zero temperature is 40.5% for the Morse dipole-dipole-2 potential, and 43.2% for the Frost-Musulin potential. The depletion increases gradually until at 3.14 K the zero momentum density becomes zero discontinuously, which indicates a transition to the ideal Bose gas. (Diss. Abstr. Int., B)

24124 GORTER-MELLINK SCALE, AND CRITICAL VELOCITIES IN LIQUID-HELIUM-II COUNTERFLOW. Dimotakis, P. E. (California Inst. of Tech., Pasadena). Phys. Rev., A; 10: No. 5, 1721-1723(Nov 1974).

It is found that, in liquid-helium-II pure counterflow, the dimensionless number $A = \rho_s A\tilde{\omega}l$ (where A is the Gorter-Mellink constant, $\tilde{\omega}$ is the mean relative velocity between the two fluids, and l is a characteristic dimension of the geometry) scales the mutual friction between the two fluids. Critical relative velocities in cylindrical channels are shown to be correlated by the rule $A_c \equiv \rho_s A\tilde{\omega}_c \pi d \simeq 1$. (auth)

24125 THEORY OF COLLISIONLESS SOUND IN SUPERFLUID ^{3}He. Serene, J. W. III. Ithaca, New York; Cornell Univ. (1974). 209p. University Microfilms Order No. 75-1450.

Thesis (Ph. D.).

Landau's kinetic equation for a normal Fermi liquid is generalized to describe Fermi liquids with even or odd-l pairing. This generalized kinetic equation is then used to study the attenuation and velocity of the collisionless density oscillation mode in a Fermi liquid with l = 1 pairing, in the limit $s = c/v_F \gg 1$. The analysis is carried out for the polar, axial, and isotopic unitary states, and the results are compared with the experiments of Paulson, Johnson, and Wheatley, and of Lawson, Gully, Goldstein, Richardson, and Lee on ultrasound propagation in the A and B phases of superfluid ^{3}He. In all three states studied there is a significant increase in the ultrasonic attenuation just below T_c. In the polar state the excess attenuation results from pair-breaking by sound quanta, and is only weakly dependent on the orientation of the anisotropic energy gap. The axial state attenuation comes from pair-breaking and also from coupling to a mode of the order parameter. The latter contribution is large and highly anisotropic. The results for the axial state are consistent with experiments in the A phase. The attenuation in the isotropic state is isotopic, and also contains pair-breaking contributions and contributions from an order parameter oscillation. In our collisionless calculation the order parameter term is singular, so a detailed comparison with experiments in ^{3}He-B requires a better calculation including collisions. (Diss. Abstr. Int., B)

24126 ELEMENTARY EXCITATIONS IN SUPERFLUID LIQUID HELIUM BASED ON THE BOGOLIUBOV-ZUBAREV FORMALISM. Rajagopal, A. K.; Grest, G. S. (Louisiana State Univ., Baton Rouge). Phys. Rev., A; 10: No. 5, 1837-1851(Nov 1974).

The Bogoliubov-Zubarev (BZ) formulation of the superfluid Bose liquid in terms of density as a collective variable leads to a non-Hermitian Hamiltonian (H_{BZ}) for describing the elementary excitations. An appropriate mathematical framework for dealing with non-Hermitian operators is here employed for the first time to develop schemes for studying the elementary excitations of the Bose liquid. The energies of the ground and the first excited states associated with H_{BZ} in "perturbation" theory are derived. A consistent scattering theory appropriate to H_{BZ} is also given from which the two-roton scattering amplitude in the leading order of "perturbation" theory is explicitly deduced. A finite-temperature Green's-function theory is also presented. These results are shown to be equivalent to those based on the Sunakawa Hamiltonian. Results for the energy spectrum are also shown to be equivalent with those evaluated by means of a variation-perturbation procedure based on the method of correlated basis functions in the uniform limit. (auth)

24127 SUPERFLUID HYDRODYNAMICS. Volume 3. Putterman, S. J. Amsterdam; North-Holland (1974). 443p. (ISBN-0-720-41258-7).

Superfluid helium is dealt with and a description of its properties is given on the basis of thermo-hydrodynamic theory. The following subjects are discussed: hydrodynamics of He II on the level where dissipative effects are ignored; hydrodynamics of He II when modified to include dissipation; applications of the He II hydrodynamics including dissipation; incorporation of thermal fluctuations in the two-fluid theory; hydrodynamics of clamped superfluid helium; the problem of critical velocities; possible shortcomings of the Landau two-fluid theory of He II; properties

of the condensed ideal Bose gas; superconducting magneto-hydrodynamics; and open problems for future research. (auth)

24128 SUPERFLUID HYDRODYNAMICS. Putterman, S. J. Low-Temperature Physics. Vol. III. North-Holland Publishing Company; Amsterdam (1974). 443p. $25.00.

Classical hydrodynamics is reviewed. Experiments which show that He II does not obey the classical hydrodynamics are discussed in detail. The superfluid hydrodynamics of He II is presented and the minimum underlying assumptions needed to derive the phenomenological theory from macroscopic first principles are discussed. Results from superfluid hydrodynamics theory dealt with include: first, second, third, fourth sound, shock waves; superfluid transverse sound; thermal and superfluid vortices; the Venturi tube; thermal superconductivity; thermal fluctuations. The viscosity paradox, the rotation paradox, quantization of circulation, and the motion and drag on quantized vortices are discussed at length and the problem of the critical velocities and possible shortcomings of the superfluid hydrodynamics are evaluated. The thermodynamics of the condensed ideal Bose gas and its relationship to the hydrodynamics of superfluid helium are treated. The chapter on magnetohydrodynamics of superconductors compares the similarities of superfluids and superconductors and analyzes the Meissner effect, quantization of the fluxoid, mixed states of type-II superconductivity, superconducting Bernoulli effects, Josephson effects, thermoelectric effects and the superconducting bulk viscosity. Open problems for future research conclude the book. (MHR)

24129 EQUATION OF MOTION FOR THE CONDENSATE DENSITY. Szprynger, A. (Inst. of Low Temperature and Structural Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 9, 973-977(1974).

The equation of motion for the condensate density ρ_c is studied on the basis of the superfluid hydrodynamics proposed by Bogolyubov. The transition rate Γ is expressed in terms of the two-fluid model parameters by the aid of the earlier derived relations between ρ_c and the particle and entropy densities, ρ, S. A comparison of the result for Γ with that obtained in the reduced-density-matrix formalism leads to a relationship between ρ_c and the superfluid density ρ_c. (auth)

24130 SOME P-WAVE PHASES OF SUPERFLUID HELIUM-3 IN STRONG-COUPLING THEORY. Barton, G.; Moore, M. A. (Univ. of Sussex, Eng.). J. Phys., C (London); 7: No. 23, 4220-4235(7 Dec 1974).

The minimization of the Landau free energy functional for p-wave pairing near T_c has been studied using a combination of analytic and numerical procedures. Eleven phases have been identified, each of which is stable in some domain of the parameters of the functional. Six of these phases have not been described before. (auth)

24131 CRITICAL TRANSPORT ANOMALIES IN 4-EPSILON AND 6-EPSILON DIMENSIONS. Gunton, J. D.; Kawasaki, K. (Kyoto Univ.). J. Phys., A (London); 8: No. 1, L9-L12(Jan 1975).

The mode coupling equations for time-dependent correlation functions are solved to lowest order in $\epsilon = d_c - d$ for several models of critical dynamics where the "conventional" theory is expected for the dimensionality d greater than d_c. The results are in agreement with recent renormalization group calculations. New results are obtained for the tricritical behavior of $^3He-^4He$, as well as for the critical amplitude of various transport coefficients. (auth)

24132 STUDY OF STATIC SCALING LAWS FOR THE TRANSITION IN LIQUID HELIUM. Marton, A. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 2, 5-9(1974). (In Rumanian).

The static scaling laws for the λ transition in liquid He with critical indices calculated on the basis of an hypothesis on the correlation function of the condensed wave function were verified. From the validity of the results proven by the Josephson relation between the superfluid density and the order parameter, the equivalence between the hypothesis proposed and the scaling hypothesis is affirmed. (tr-auth)

24133 FIELD THEORETIC APPROACH TO ELEMENTARY EXCITATION IN SUPERFLUID LIQUID HELIUM. Grest, G. S. Baton Rouge, LA; Louisiana State Univ. (1974). 172p. University Microfilms Order No. 75-1927.

Thesis (Ph. D.).

Several theories have been developed to derive the Landau phonon-roton spectrum for superfluid liquid helium. The various methods are presented in a unified manner which brings out their complete equivalence. Arguments are given which seem to indicate that a modified version of the Bogolyubov approximation for a weakly interacting gas may be equivalent to the density variable approaches, pioneered by Nishiyama, Berdahl and Bloch, Bogolyubov and Zubarev (BZ), and Sunakawa and co-workers. In these theories, density is used as a coordinate to describe the fluid. In the first two theories, the single particle Bose operators are expressed in terms of density and another variable which are consistent with their basic commutation relations. In the latter two, a current operator is introduced which with the density forms a closed algebra. It is shown that the variables, density and current, give a complete description of a system of spinless, identical bosons. At T = 0K, a particular choice of the algebra containing only the longitudinal component of the current describes the fluid in a simple way. For a Bose system, there exists an irreducible representation of this algebra which leads to all the density formulations mentioned above. In the first two theories, the structure of the current operator is verified by explicitly calculating it and comparing it with the irreducible form. With this demonstration, the formal equivalence of these formulations is established. Connection is also made to a modified version of the Bogolyubov approach via a unitary transformation. The BZ formalism leads to a non-Hermitian Hamiltonian which contains only a finite number of interaction terms, while that of Nishiyama or Sunakawa is an infinite series, Hermitian Hamiltonian. An appropriate mathematical framework for dealing with the non-Hermiticity of the BZ Hamiltonian is employed to develop schemes for studying the elementary excitations of the Bose fluid. The energies of the ground and first excited states, the liquid structure factor, the number of particles in the zero momentum state, and the two roton scattering amplitude are derived in "perturbation" theory. A finite temperature matrix Green's function theory is also developed. The excitation energy and the liquid structure factor are calculated from it in a straightforward way. These results are applied to compute numerically the excitation spectrum of the superfluid liquid helium using the experimental structure factor as the only input into the computation. The dependence on the unknown helium interatomic potential is thus eliminated. Comparison of this with other calculations and with experiment are discussed in detail. The development given here can also be applied to other boson systems such as the charged Bose gas. (Diss. Abstr. Int., B)

24134 LIGHT SCATTERING IN ^{4}He NEAR THE GAS-LIQUID CRITICAL POINT: THE TURBIDITY AND RAYLEIGH LINEWIDTH. Koenig, A. A. III. Durham, NC; Duke Univ. (1974). 149p. University Microfilms Order No. 75-2393.

Thesis (Ph. D.).

Opalescence of a sample of helium-4 was observed in the neighborhood of its gas-liquid critical point. Simultaneous recordings of the linewidth associated with the Rayleigh component of the scattered spectrum, and the turbidity of the sample were made as a function of the temperature difference, (T-Tc), where Tc is the critical temperature. All measurements were performed along the critical isochore, and in the single phase region, that is, for $T \geq Tc$. An argon-ion laser was designed and constructed in this laboratory to provide a continuous coherent source of single frequency radiation. The laser offered several distinct advantages for optical spectroscopy. The discrete frequency tunability in the blue-green region of the spectrum matched the frequency range for maximum quantum efficiency of the photomultiplier tube. In addition, the Rayleigh scattered intensity is inversely proportional to the fourth power of the incident wavelength, thus providing an increase in the signal power over more conventional lasers. The beam was spatially filtered, expanded and focussed approximately two meters away into the sample cell. A pair of 45° mirrors surrounded the cell to direct the narrow pencil of light, approximately 0.1mm in diameter, horizontally through the sample. Scattered light at 12° from the incident direction was selected for study by a conical lens and annular apertures placed strategically along the output tube. The transmitted beam was fully enclosed within a separate tube held at the center of the scattered light tube via the annular stops. This beam was then apertured to allow only a 2 milliradian divergence to be examined, thereby removing most of the small angle scattered light. The scattered light was then directed to a photomultiplier, where a self beating (optical homodyne spectroscope) took place, translating the information to audio frequencies. The resulting electronic signal was frequency analyzed and automatically digitally recorded via a parallel to serial punch drive interface feeding an IBM024 card punch. One hundred sample points were punched over the 500 second scan time of the sweeping analyzer. This data was then fitted to a Lorentzian curve by a computer program, and the linewidth determined. Linewidths corresponding to temperatures in the range $0.001 \leq (T-Tc) \leq 0.050°K$, were then fit to a power series term in the reduced temperature, (T-Tc)/Tc after subtracting out the background contributions to the linewidth. The resulting exponent $(\gamma-\psi)$ was determined to be 0.68 ± 0.02. This value is in reasonable agreement with dynamic scaling theory and Ising model predictions for the divergence of the diffusivity, and the results reported for SF_6, Xe and CO_2. Simultaneously, the transmitted intensity was compared to a variable

reference derived via a beamsplitter from the original beam. The two beams were chopped and appeared consecutively on the surface of a second photomultiplier tube. The signal was fed to a lock-in, and the DC output from the detector drove a servo motor, turning the attenuator until a lock was achieved. The attenuator angle was then recorded as a function of temperature to an ultimate precision of 3 seconds of arc. The turbidity was plotted on a log–log plot as a function of the reduced temperature, t, and a straight line fit was observed for (T–Tc) > 20m°K. This behavior is theoretically related to the divergence of the isothermal compressibility, K_T, for which the value of the exponent $\gamma = 1.29 \pm 0.01$ was determined. The data below 20m°K bend away from the straight line owing to the increasing correlation range in this region. We compute from this part of the data the coefficient, ξ_0, and the exponent, ν, which characterize the divergence of the correlation length. The values we find are $\xi_0 = 3.5 \pm .0.2$Å, and $\nu = 0.67 \pm 0.02$. Finally, the results of the linewidth and turbidity measurements are combined with the dynamic scaling relation $(\gamma-\psi) = \nu$ to obtain a measure of the divergence of the thermal conductivity. This transport property is calculated to diverge with an exponent $\psi = 0.61 \pm 0.03$. (Diss. Abstr. Int., B)

24135 THEORETICAL STUDY OF THE PHYSICAL PROPERTIES OF FERMI FLUIDS AT FINITE TEMPERATURES. Rainwater, J. C. Boulder, CO; Univ. of Colorado (1974). 277p. University Microfilms Order No. 75-3820.

Thesis (Ph. D.).

The Landau theory of a Fermi fluid is applied to the calculation of low-temperature equilibrium and transport properties of Fermi fluids in general and liquid helium three and the dilute hard-sphere Fermi gas (DHSFG) in particular. The momentum dependence of Landau's quasiparticle energy ξ_k^0 and the angular average of Landau's interaction energy (f-function) $f(\vec{k}, \vec{\sigma}; \vec{k}', \vec{\sigma}')$ is presented in a parameterized form inferred from exact DHSFG solutions for the cited quantities. A set of identities relating the parameters of ξ_k^0 and f is derived; these identities serve as a useful consistency check on the theory. (MHR)

24136 p-WAVE MODELS FOR THE A-PHASE OF SUPERFLUID ^{3}He. Stare, G. B. Ithaca, NY; Cornell Univ. (1974). 187p. University Microfilms Order No. 75-4268.

Thesis (Ph. D.).

The general fourth order p-wave pairing free energy was minimized under the following two constraints suggested by data in the A-phase of superfluid ^{3}He: (I) The net nuclear magnetization of the A-phase vanishes in the absence of an applied magnetic field, i.e., the Cooper pairs have no spontaneous magnetization. (II) The magnetic susceptibility of the A-phase is hardly different from its normal state value. The complete solution incorporating these constraints reveals six distinct p-wave phases. Two of the phases, however, are unstable against general variations in the (full 18 component) order parameter when constraints I and II are relaxed. The other four can be local minima of the full unconstrained p-wave free energy. They include the axial and polar phases which had been discovered before, and two new phases which we call "axi-planar" and "bi-polar". These four phases are the only stable p-wave models for a phase with properties I and II. The application of Leggett's theory of nuclear magnetic resonance in ^{3}He shows that the bi-polar and polar phases do not have unique resonance shifts. One would expect a signal strongly dependent on sample geometry. The axi-planar phase like the axial should have well determined longitudinal and transverse resonance shifts. In contrast to the axial phase, however, in the axi-planar there are two transverse resonances, and the simple relation $\omega_l^2 = \omega_t^2 + \omega_t^2$ between the transverse (t), longitudinal (l), and Larmor (L) frequencies does not hold. Hence, the axial phase seems to be the only one wholly compatible with the NMR data. However, the properties of the axiplanar phase approach those of the axial phase near the boundary between the two phases. States of ^{3}He–A were also found in a strong magnetic field in the A_1-phase and in the A_2-phase close to the phase boundary. There exist five types of solutions. In some regions of parameter space the analytic form of the solution appears to change as the temperature is lowered much below the A_2-transition temperature indicating the possibility of another transition in the intermediate temperature range. (Diss. Abstr. Int., B)

24137 DOMAIN OF TWO–DIMENSIONAL EXCITATIONS IN SUPERFLUID HELIUM FILMS. Washburn, T.E.; Rutledge, J.E.; Mochel, J.M. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61820). Phys. Rev. Lett. 34: No. 4, 183-186 (27 Jan 1975).

Using third–sound resonance, we find for helium film thickness less than 2.8 atomic layers that there exist excitations which are phononlike and two dimensional, obeying a T^3 law, that their areal density is independent of film thickness, and that their velocity (using Landau theory) is 76±2 m/sec. This velocity is slightly above the maximum third–sound velocity, 69 m/sec, that can be attained by ^{4}He on argon. For thicker films the areal density of these excitations becomes smaller. (auth)

24138 SURFACE ORIENTATIONAL EFFECTS IN B–He^3. Osheroff, D.D.; Engelsberg, S.; Brinkman, W.F. (Bell Laboratories, Murray Hill, New Jersey 07974); Corruccini, L.R. Phys. Rev. Lett. 34: No. 4, 190-193 (27 Jan 1975).

We present measurements of large transverse resonance frequency shifts in NMR studies on superfluid B–He^3 contained in narrow channels separated by flat Mylar sheets. From these shifts we determine the orientation of the anisotropy axis with respect to the external field, and show that it is accurately determined by existing theory. We discuss the field dependence of the resonance shifts and present several new theoretical results which allow us to determine H_BR_C from our data. (auth)

24139 ANISOTROPY IN SUPERFLUID ^{3}He AND THE ATTENUATION OF ZERO SOUND. Lawson, D.T. (Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850); Bozler, H.M.; Lee, D.M. Phys. Rev. Lett. 34: No. 3, 121-124 (20 Jan 1975).

The attenuation of 20–MHz zero sound in superfluid A–^{3}He has been studied as a function of angle between the sound propagation direction and an applied magnetic field, and found to be anisotropic. (auth)

24140 EXCITATIONS AND THERMODYNAMICS FOR LIQUID–HELIUM FILMS. Saam, W.F. (Department of Physics, The Ohio State University, Columbus, Ohio 43210); Cole, M.W. Phys. Rev. B 11: No. 3, 1086-1105 (1 Feb 1975).

We derive a hydrodynamic theory of the long–wavelength excitations of helium films adsorbed in cylindrical pores and on planar substrates. In the case of cylindrical geometry, the spectrum exhibits an instability for a particular value of the ratio of the film surface radius to the pore radius. This instability condition is shown to coincide with a thermodynamic instability condition determined by the relative magnitude of the surface energy and the energy of interaction with the substrate. Calculated adsorption isotherms show a corresponding hysteresis in good agreement with measured values. We suggest the possibility that the soft modes present for films thinner than the unstable limit mediate an attractive interaction between quasiparticles of a He^3 film adsorbed on the He^4, leading to a new kind of He^3 superfluid. Similar calculations are presented for the spectrum of He^4 on a planar substrate. In this case, as well as in the cylindrical case, surface excitations (ripplons) dominate the thermodynamic properties at low temperature ($T \lesssim 0.1$ K). In this regime the properties are a simple function of the dimensionality of the surface. At higher T, short–wavelength modes contribute, and the results depend in a complicated fashion on the finite dimensions of the system. We discuss the available data, where possible, and suggest further experiments. (auth)

24141 MICROSCOPIC THEORY OF SURFACE EXCITATIONS IN SUPERFLUID He^4. Chang, C.C.; Cohen, M. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. B 11: No. 3, 1059-1065 (1 Feb 1975).

A many–body wave function, similar to the Feynman wave function for bulk excitations in liquid helium, is proposed for the surface excitations. A discrete surface excitation is found to exist for $k < 2.0$ Å^{-1}; its energy is calculated both variationally and by solution of an effective one–body Schrödinger equation. The latter also permits calculation of the effect of the surface on the bulk excitations. The absence of backflow in the wave function is a serious defect for $k \gtrsim 0.8$ Å^{-1}. (auth)

24142 HYDRODYNAMICS OF ^{3}He IN ANISOTROPIC A PHASE. Graham, R. (Univ., Stuttgart). Phys. Rev. Lett.; 33: No. 24, 1431-1434(9 Dec 1974).

The hydrodynamic theory of mass transport in A-^{3}He is derived from that phase's broken symmetries and thermodynamics. First, second, and fourth sound as well as orbit waves are obtained as the normal modes. (auth)

Superconductivity

Refer also to abstracts 22507, 22528, 23146, 23149, 23192, 23220, 23255, 23274, 23276–23278, 23288, 23291, 23295, 23301, 23303, 23327, 23382, and 24128.

24143 (AD-778374) NONEQUILIBRIUM PROPERTIES OF SUPERCONDUCTIVITY INDUCED BY NUCLEAR RADIATION. Report No. 2 (Final), 1 April 1972–31 January 1974. Dick, G. J.; Mercereau, J. E.; Owen, C. W.; Scalapino, D. J.; Shepard, K. W. (Research Advisory Inst., Inc., South Laguna, Calif. (USA)). 29 Mar 1974. Contract N00014-72-C-0331. 64p. NTIS $3.75.

Certain of the dynamic effects associated with the interaction of energetic nuclear particles with the superconducting state are examined. Also included is a brief discussion of the effects of thermal heating due to massive radiation on superconductivity. Calculations are done on the space-time evolution of the superconducting energy gap along a single particle track in a superconductor. These results are then applied to a Josephson tunnel junction in order to determine the time response of such a junction to nuclear impacts. Experimental results are reported on the dynamic response of superconducting aluminum films to single 6-MeV alpha particles. It was found that the relaxation effects following nuclear impact, reported here, were probably dominated by ballistic phonon processes and had a temperature dependent relaxation time ranging from 10 to 100 nanoseconds. (auth)

24144 (AD-785014) SUPERCONDUCTING PROPERTIES OF BULK AND THIN FILM A15 COMPOUNDS. Somasundaram, R.; Toth, L. E.; Spitzer, H. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering). 1973. Contract DAAK02-70-C-0181. 118p. NTIS $9.00.

Superconducting properties of cast and heat treated alloys of niobium with Al, Ge, and Ga were studied as a function of composition and heat treatment. Structure and composition of alloys were studied with x-rays, metallography, and electron-microprobe analysis. These studies indicated that the improvement in transition temperature resulted from changes in composition of the AL5 phase which occur during heat treatment. Thin films of some of the Al5 Nb alloys were sputtered as a function of applied voltage and substrate temperature from a compound target. Sputtered films of Nb–Sn with a T_C of 15.6 K and Nb–Ge films with a T_C of 17 K were obtained. Sputtered films of Nb–Al, Nb–Ga, and Nb–Al–Ge had poor superconducting properties mainly due to the absence of the Al5 phase. The results indicated that the sputtering variables affect the superconducting properties by varying the structure and composition of the film. (GRA)

24145 (JUL-1126-FF) SUPERCONDUCTIVITY, ELECTRICAL RESISTIVITY, AND THE STRUCTURAL PROPERTIES OF LANTHANUM UNDER PRESSURE. Balster, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Oct 1974. 65p. (In German). Dep. NTIS (US Sales Only) $6.25.

Thesis. Submitted to Bochum Univ., West Germany.

High precision resistivity measurements of lanthanum between 300 K and liquid helium temperature under pressures up to 200 kbar reveal anomalies both in the residual and the phonon resistivity. The transition temperature to the superconducting state, T_c, increases with pressure, showing anomalies at about 25 and about 53 kbar. T_c reaches a limiting value of 12.9 K just under 200 kbar. The measurements indicate two new first-order crystallographic phase transitions at low temperatures. A tentative T-P phase diagram is constructed suggesting that it is possibly isomorphic to that of cerium. In addition, the phase transition of AgCl occurring at room temperature and 76 kbar was followed down to 4 K and 52 kbar. (auth)

24146 PHENOMENOLOGICAL MODEL EXPLAINING THE SUPERCONDUCTING PROPERTIES OF COMPOUNDS WITH THE A-15 STRUCTURE. Bongi, G.; Fischer, O.; Jones, H. (Univ., Geneva). J. Phys., F (London); 4: No. 12, L259-L262(Dec 1974).

A new approach is given to explain the superconducting properties of the A15 compounds (e.g., Nb_3X, V_3X, Mo_3X, Ti_3X) based on the local character of each constituent and the notion of charge transfer. (auth)

24147 SUPERCONDUCTING UPPER CRITICAL FIELD IN DILUTE NIOBIUM MOLYBDENUM ALLOYS. Somekh, R. E. (Cambridge Univ., Eng.). J. Phys., F. (London); 4: No. 12, 2231-2238(Dec 1974).

Experimental results of $\kappa_1(t)/\kappa_1(1)$ are presented for dilute superconducting niobium molybdenum alloys. Results are also given of some model calculations of $\kappa_1(t)/\kappa_1(1)$ based on a theory of Hohenberg and Werthamer (Phys. Rev.; 147:288 (1967)). The theory takes account of the anisotropic Fermi velocity. The main conclusion is that this theory can explain $\kappa_1(t)/\kappa_1(1)$ in dilute niobium alloys. It appears that the approach to "dirtiness" occurs at shorter mean free paths than previously thought in these alloys. (auth)

24148 SUPERCONDUCTIVITY AMONG COMPOUNDS WITH SPINEL STRUCTURE AND THE STRONG COUPLING MECHANISM. Dawes, P. P.; Grimes, N. W. (Aston Univ., Birmingham, Eng.). Solid State Commun.; 16: No. 1, 139-141(1 Jan 1975).

X-ray diffraction and related investigations of the sulphide and selenide spinels ($CuRh_2S_4$ and $CuRh_2Se_4$) indicate that the mechanism for superconductivity among these materials is very closely allied to that existing in the β-tungsten and NbN systems. The potential well at the octahedral sites is almost certainly anharmonic and the spinels thus appear to be the first ternary compounds for which the high T_c mechanism holds. (auth)

24149 ANOMALOUS SPECIFIC HEAT IN La:Ce ALLOYS. Culbert, H. V.; Edelstein, A. S. (Argonne National Lab., IL). Solid State Commun.; 15: No. 10, 1633-1638(15 Nov 1974).

The magnetic contribution to the specific heat in La:Ce alloys shows a broad anomaly at ≈ 1.2°K which is weakly dependent on the concentration. This anomaly, which accounts for a substantial portion of the entropy of a doublet, cannot be attributed to either usual magnetic ordering or to a dilute alloy Kondo effect, but may represent the behavior of a concentrated Kondo system. (auth)

24150 INTERPOLATION SCHEME FOR THE KONDO CONDENSATION APPLIED TO THE STUDY OF ITS EFFECT ON THE TRANSITION TEMPERATURE OF A SUPERCONDUCTOR. Prejean, J. J.; Souletie, J.; Teixeira, J. (CNRS, Grenoble, France). J. Phys., F (London); 5: No. 1, L6-L10(Jan 1975).

The Kondo compensation is pictured in terms of a temperature-dependent effective spin value $S_{eff} = S\xi(T/T_k)$. This suggestion is supported experimentally and was shown previously to be coherent with the Hamann's approach to the resistivity problem if $J\rho S = (1/2\pi)\sin[2\,S_{eff}\pi/(21+1)]$ and $\xi(T/T_k) = \frac{1}{2} + (1/\pi)\tan^{-1}[(1/\pi S)\ln T/T_k]$. Using this determination with the Abrikosov–Gorkov expression, the well known result of Muller–Hartmann and Zittartz on the depression of the superconducting transition temperature is obtained without any calculation and generalized to $S \neq \frac{1}{2}$, $1 \neq 0$. (auth)

24151 RELATION BETWEEN NORMAL STATE PROPERTIES AND T_c FOR SOME Zr_3X COMPOUNDS. Fisk, Z. (Univ. of California, La Jolla, San Diego); Viswanathan, R.; Webb, G. W. Solid State Commun.; 15: No. 11-12, 1797-1799(15 Dec 1974).

It is found that a certain feature of the normal state resistivity correlates with T_c in a closely related group of superconductors. (auth)

24152 THERMAL CONDUCTIVITY OF SUPERCONDUCTING NIOBIUM. Mamyia, T.; Oota, A.; Masuda, Y. (Nagoya Univ., Japan). Solid State Commun.; 15: No. 10, 1689-1692(15 Nov 1974).

The phonon scattering term in the superconducting state of the electronic conduction has been obtained for niobium which is regarded as an intermediate coupling superconductor. The limiting slope for the phonon scattering term of the reduced thermal conductivity against reduced temperature has been found to be 2.8, as compared with 1.5 for weak coupling superconductors. (auth)

24153 RELAXATION PROCESSES AND CURRENT DESTRUCTION OF SUPERCONDUCTIVITY IN SMALL SAMPLES. Peskovatskii, S. A. (Physical-Technical Inst. of Low Temperature, Kharkov). Solid State Commun.; 16: No. 1, 19-21(1 Jan 1975).

The model of the current transition between the superconducting and resistive states in the superconductors with small dimensions is proposed. The model takes into account the relaxation processes. The non-thermal current hysteresis, incomplete superconductivity destruction by current, unstable current states and some other features of the current transition find explanation in the framework of the proposed model. (auth)

24154 MICROSCOPIC THEORY OF THE ANISOTROPIC ELECTRON–PHONON SYSTEM IN TYPE II SUPERCONDUCTORS. Teichler, V. H. (Univ., Stuttgart). Phil. Mag.; 30: No. 6, 1209-1222(Dec 1974). (In German).

Taking into account the microscopic anisotropy of the electron band structure, of the electron–phonon interaction, and of the phonon spectrum, Eliashberg's (Eliashberg, G. M., 1960, Soviet Phys. JETP, 11: 696) theory of the superconducting electron-phonon system is extended to superconductors in magnetic fields. Within this formalism an explicit expression for the thermodynamic potential of the superconducting state is presented, which may serve as a starting point for approximate descriptions of the mixed or intermediate state of anisotropic metals. (auth)

24155 CRITICAL TEMPERATURE OF SUPERCONDUCTORS WITH OPTICAL BRANCHES IN THE PHONON SPECTRA. Korsunskii, M. I.; Genkin, Ya. E.; Zavodinskii, V. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 5-9(1974). (In Russian).

Formulas were obtained for the critical temperature of superconductors with optical branches in the phonon spectra. It was shown that the interaction of electrons with optical phonons leads to supplementary electron–electron attraction and promotes the appearance of the superconducting state above the critical temperature. (tr-auth)

24156 LOCALIZED SPIN FLUCTUATIONS IN SUPERCONDUCTING ALLOYS. Kiwi, M.; Roessler, J. (Univ. of Chile, Santiago). Solid State Commun.; 15: No. 10, 1581-1584(15 Nov 1974).

The effects due to localized spin fluctuations (LSF) in dilute superconducting alloys are investigated. Expressions for the critical temperature T_c as function of impurity concentration n_I and the specific heat jump at the transition $\Delta C(T_c)$ are obtained, both in the weak and strong magnetic limits. The results are discussed in the light of available experimental data. (auth)

24157 JOSEPHSON EFFECT AND ITS APPLICATIONS. Dolocan, V. (Univ., Bucharest). Stud. Cercet. Fiz.; 26: No. 5, 535-549(1974). (In Rumanian).

Some fundamental topics concerning the Josephson effect are discussed. It treats the dc and ac effects, the magnetic field dependence of the critical current, and the Josephson junction as relaxation oscillations generator. Formulas for the phase difference and the Josephson current density are given. Finally, some applications of the Josephson effect are briefly reviewed. (auth)

24158 DIRECT EXPERIMENTAL EVIDENCE FOR LOW TEMPERATURE ANHARMONICITY IN SUPERCONDUCTING SPINELS. Dawes, P. P. (Aston Univ., Brimingham, Eng.); Grimes, N. W.; O'Connor, D. A. J. Phys., C (London); 7: No. 21, L387-L389(7 Nov 1974).

Preliminary experimental data are reported for the absolute values and temperature dependence of the Moessbauer recoil-free fraction of ^{119}Sn in the superconducting spinel $CuRh_{1.95}Sn_{0.05}Se_4$. The results are consistent with earlier investigations which indicated the presence of an anharmonic potential well at the octahedral sites. (auth)

24159 CALCULATING THE ELECTRON–PHONON INTERACTION CONSTANT IN STRONG COUPLING SUPERCONDUCTORS. Pan, V. M.; Pashitskii, E. A.; Prokhorov, V. G. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1298-1302(Aug 1974). (In Russian).

The expression obtained earlier for the critical temperature of superconducting transition T_c more precise than the McMillan formula was analyzed. Five well-studied superconductors: Pb, Hg, Sn, In and Al were examined. The electron phonon interaction constants λ and indices of isotopic shift β were found, using electronic specific heat capacity and positronic annihilation experimental data. The results were compared with empirical and experimental values λ^{emp} and β^{exp}. Satisfactory agreement was observed between λ and λ^{emp} as well as between β and β^{exp}. The values of λ obtained in the research differ in many cases from those calculated from the McMillan and Dynes formulas, or according to the pseudopotential calculations. (auth)

24160 PROXIMITY EFFECTS AND THE GENERALIZED GINZBURG–LANDAU EQUATION. Blackburn, J.A. (Physics Department, Wilfrid Laurier University, Waterloo, Ontario, Canada); Smith, H.J.T.; Rowell, N.L. Phys. Rev. B 11: No. 3, 1053-1058 (1 Feb 1975).

A computer program has been developed which finds solutions of the generalized Ginzburg–Landau equation subject to de Gennes's boundary conditions. The resulting information on the spatially varying order parameter is then interpreted *vis–à–vis* experimental data on both superconductor–insulator–normal–metal–superconductor Josephson tunneling systems, and ultrasonic–surface–wave attenuation. (auth)

24161 FLUXONS IN DUAL THIN FILMS. Manson, J.R.; Sherrill, M.D. (Department of Physics and Astronomy, Clemson University, Clemson, South Carolina 29631). Phys. Rev. B 11: No. 3, 1066-1069 (1 Feb 1975).

The field and current distribution for a fluxon penetrating two thin parallel films is obtained. This result is used to calculate the coupling force for an isolated fluxon extending through the two films. The calculation is valid for arbitrary separation between the films when $d_1 \ll \lambda_1$, $d_2 \ll \lambda_2$, and the fluxon core radii are much less than λ. Here d_1 and d_2 are the film thicknesses and λ_1 and λ_2 are the penetration depths. The conditions of validity of a previous calculation for zero separation between the films are established, and the comparison with recent experimental work is discussed. (auth)

24162 POSSIBILITY OF EXISTENCE OF ELECTRONIC SOUND WAVES IN SUPERCONDUCTORS. Aronov, A.G.; Gurevich, V.L. (Leningrad Institute of Nuclear Physics, USSR Academy of Sciences). JETP Lett. 20: No. 5, 147-148 (5 Sept 1974).

It is shown that electronic oscillations of the acoustic type, with finite amplitude, are possible in a superconductor at $T \sim T_c$, although the small–amplitude oscillations attenuate strongly. The velocity of such sound is on the order of the Fermi velocity and depends little on the temperature. (auth)

24163 TRANSITION FROM QUASIPARTICLE TUNNELING TO THE JOSEPHSON EFFECT IN S-c-S CONTACTS. Avakyan, R. S.; Gubankov, V. N.; Margolin, N. M. (Radio Engineering and Electronics Inst., Moscow). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 5, 986-987(Nov 1974).

Translated from Fiz. Tverd. Tela; 16: No. 5, 1523-1525(May 1974).

The results of a study of the conditions for the transition from quasi-particle tunneling to the Josephson effect in high-impedance S-c-S contacts are reported. The experiments were performed with clamped niobium point contacts, in which the ratio of the resistance at room temperature to that at temperatures close to the critical point T_c is 3:1, so that the mean free path in bulk niobium at $T \approx T_c$ was ~3000Å. (MHR)

24164 CRYSTALLOCHEMICAL ANALYSIS OF SUPERCONDUCTING COMPOUNDS OF THE TYPE $A_3^VB^{IV}$. Palatnik, L. S.; Fal'ko, I. I. (Kharkov Polytechnic Inst.). Dokl. Akad. Nauk SSSR; 217: No. 3, 573-576(1974). (In Russian).

The superconducting compounds of the $A_3^VB^{IV}$ type with A-15 lattices, in which A^V is V, Nb, or Ta and B^{IV} is Pb, Sn, Ge, or Si, have excited interest because many of them have very high values of T_c. On the basis of a crystallochemical analysis of known superconducting compounds of this type, predictions are made on the values of the structural parameters and critical temperatures of new compounds. It is concluded that the double carbides, silicides, and germanides of V, Nb, and Ta and multicomponent phases of solid solutions of these elements might have relatively high values of T_c. (JSR)

24165 FILM DEPOSITION OF Nb-BASED A15 SUPERCONDUCTORS. Kammerdiner, L. W. San Diego, CA; Univ. of California (1974). 165p. University Microfilms Order No. 75-4642.

Thesis (Ph. D.).

The Nb_3X, A15 structure alloys with X in the IIIA or IVA column of the periodic table, exhibit the highest superconducting transition temperature (T_c) out of all of the presently known superconductors. In terms of applications, there are two important areas of study: i) the formation of the high T_c material in a useful, coherent form and ii) the synthesis of new materials that might lead to even higher T_c materials. First, due to the extreme brittleness of the A15 alloys, they can not be drawn into wires. It is, therefore, interesting to investigate these materials for the possibility of synthesizing a high T_c film. Second, in these two columns of the periodic table a limited amount of work has been reported on Nb_3In, Nb_3Pb, and Nb_3Tl, the latter alloy having not been previously reported with an A15 crystal structure. In searching for higher T_c materials, it is important to synthesize these compounds and to determine the T_c, regardless of whether it is low or high. Two slightly different methods of preparation were employed. In the first part of this investigation Nb_3Al and Nb(Al,Ge) (at that time the highest T_c superconductor) were formed by sputtering and were studied for general crystal structure properties and for superconductivity. Lattice constants and T_c were measured and compared with a set of fast-quenched bulk samples, alloyed for that purpose. Measurements were performed for both as-sputtered and as-quenched samples and for the same samples after annealing. For ternary samples, only the results for films are presented. The highest T_c for a $Nb_3(Al,Ge)$ film was 17.2°K. The second phase of this study involved the investigation of new A15 materials, in particular Nb_3In, Nb_3Pb, and Nb_3Tl. These were successfully synthesized by a process of simultaneous sputtering and evaporation. These were studied as a function of substrate temperature, which had a strong effect on the formation of the A15 phase. Lattice constants were measured for all samples and found to increase as substrate temperatures decreased. T_c was also measured and found to be below 9°K (the transition temperature of pure Nb) for Nb_3In, Nb_3Pb, and Nb_3Tl films is discussed. (Diss. Abstr. Int., B)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 22740, 24402, and 24404.

24166 (JINR-16-7381) MAGNETIC FIELD EFFECT ON NEUTRON REFLECTION FROM HELIUM MEDIA. Lomidze, V. L.; Shabalin, E. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 14p. (In Russian). INIS.

Monte Carlo calculations were made of the contribution of a to the albedo plane He reflection caused by the polarization of neutrons during their scattering on ^{4}He. The dependence of the effect of a on the magnitude and direction of the magnetic field in the He medium, on the angular and energy distribution of the incident neutrons, and the thickness of the scattering medium was studied. (tr-auth)

24167 METHOD OF STUDYING SURFACE PROPERTIES RELEVANT TO ULTRA-COLD NEUTRONS. Golub, R.; Pendlebury, J. M. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Phys. Lett., A; 50: No. 3, 177-178(2 Dec 1974).

Surface contamination which is severe enough to account for the observed anomalous absorption of ultra-cold neutrons can be detected by the effects this contamination would have on the reflection of sub-thermal neutrons. (auth)

24168 COMMENTS ON HALF-SPACE PROBLEMS WITH QUADRATIC ANISOTROPY OF SCATTERING. Claussen, K.; Thielheim, K. O. (Univ., Kiel). Kernenergie; 17: No. 8, 253-258(Aug 1974).

Milne's and albedo problems with quadratic anisotropy of scattering in homogeneous media are considered. Classification and dependence of discrete eigenvalues on the parameters c of particle reproduction and b_2 of anisotropy of scattering are discussed. The X function is evaluated for some parameters c and b_2 along the negative real axis. The extrapolated endpoint, albedo, and boundary values are calculated explicitly. The dependence of extrapolated endpoint and boundary values on parameters c and b_2 is represented in graphical form. (7 figures, 1 table) (auth)

24169 ENDF/B FILE FOR DOSIMETRY APPLICATIONS. Magurno, B. A. (Brookhaven National Lab., Upton, NY); Ozer, O. Nucl. Technol.; 25: No. 2, 376-380(Feb 1975).

The present dosimetry file consists of 36 reactions in 26 isotopes and is being issued with Version IV of the ENDF/B library. The file evolved from the efforts of the Normalization and Standards Subcommittee of the Cross-Section Evaluation Working Group to review the status of multigroup cross-section sets used for dosimetry purposes in the Interlaboratory LMFBR Reaction Rate (ILRR) program. The recommendation of the subcommittee was the creation of a multigroup library based on the best available estimates of microscopic data even though these data might not initially agree with some of the integral tests. A task force to assemble this library was drawn from the subcommittee and member laboratories in the ILRR program. The library was tested with procedures similar to those used on the ENDF/B general file. Phase-I tests included processing with computer codes CHECKER to be sure the dosimetry file complied with the standard ENDF format and INTER to calculate the resonance integral of the exoergic reactions in the file. Phase II consisted of calculating spectrum-averaged cross sections with a variety of spectra and comparing the results with designated integral results. (auth)

24170 COMPRESSION AND FOCUSING OF A NEUTRON GAS BY MOVING THE MODERATOR. Askar'yan, G.A.; Namiot, V.A. (P. N. Lebedev Physics Institute, USSR Academy of Sciences Nuclear Physics Institute, Moscow State University). JETP Lett. 20: No. 5, 148-149 (5 Sept 1974).

It is shown that when a moderator moves in a neutron gas it is possible to rake the neutrons together and increase their density in the moderator and ahead of the moderator, a fact that can be used to increase the concentration of the reactions induced by neutrons and their energy release, and to enhance self—expansion and self—contraction of a cavity in matter. The possibility of inertial shaking—off and focusing of neutrons by rapid deceleration of matter is demonstrated. The question is raised of the distribution of the neutrons in the medium having a density and velocity distribution. (auth)

24171 THE EFFECTS OF DELAYED NEUTRONS IN THE NEUTRON PULSE PROPAGATION PROBLEM. Singh, O. P. (Reactor Research Centre, Kalpakkam (India). Fast Breeder Test Reactor Design Group). Atomkernenergie; 24: No. 2, 95-97(1974).

A study of the effects of delayed neutrons in the neutron pulse propagation problem has been made by solving the time- and energy-dependent neutron transport equation by using the Laplace transform technique and simple scattering kernel. Numerical calculations have been performed for water moderator, and the results are compared with the corresponding analysis made by neglecting delayed neutrons. (auth)

24172 ON A SYNTHETIC SCATTERING KERNEL IN NEUTRON THERMALIZATION. El-Wakil, S. A.; Hathout, A. M.; Youseff, M. Y. A. (Atomic Energy Establishment, Cairo (Egypt)). Atomkernenergie; 24: No. 2, 103-104(1974).

With a degenerate representation as a starting point, the slowing-down density can be expressed in terms of a Green function of the Sturm—Liouville equation. This permits us to obtain higher-order terms of the Fourier expansion of the slowing-down density and the corresponding flux. It is also shown that the scattering kernel is expressible in terms of the associated Laguerre functions. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 23505, 23859, 23973, 24086, 24198, and 24222.

24173 CALCULATION OF THE (γ,n) AND (γ,p) CROSS SECTIONS FOR ^{4}He IN A CONTINUUM SHELL-MODEL APPROXIMATION. Chung, A. H.; Johnson, R. G.; Donnelly, T. W. (Toronto Univ., Ontario (Canada). Dept. of Physics). Nucl. Phys., A; 235: No. 1, 1-10(9 Dec 1974).

The photonucleon reaction has been studied by using a straightforward extension of bound-state shell-model theory. Continuum wave functions are replaced by their value at the center of small energy intervals. When this process is truncated at some maximum excitation energy, a finite set of wave functions describing the continuum is produced. Calculations are performed using a finite square well and a zero-range residual interaction in the 1p—1h space. Application of the method is illustrated by calculating the photoneutron and photoproton cross sections and angular distributions for ^{4}He. Good agreement between the calculated cross sections and most experimental data is obtained. (auth)

24174 THE BOUNDARY CONDITION APPROACH TO NUCLEON—NUCLEON POTENTIALS AND THE CALCULATION OF THE T- AND K-MATRICES. Efimov, V. N.; Schulz, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Nucl. Phys., A; 235: No. 2, 436-449(16 Dec 1974).

It has been shown that the off-shell T- and K-matrices can be obtained by means of boundary conditions imposed upon the off-shell wave function only. When there is a potential outside the boundary condition radius, the method proposed permits one to deduce in a rather simple way a renormalized Lippmann—Schwinger equation. The S components of the T- and K-matrices are considered in detail by using a potential of the exponential type in the exterior region. For such types of potentials a rather effective method for factorizing the K-matrix is given. Parameter fits to the $^1S_0$ and $^3S_1$ phases are presented. (auth)

24175 DETERMINATION OF NUCLEAR SPECTROSCOPIC FACTORS FROM DATA ON DIFFERENTIAL CROSS SECTIONS FOR ELASTIC NEUTRON SCATTERING ON LIGHT NUCLEI. Dubnicka, S.; Dumbrajs, O. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., A; 235: No. 2, 417-427(16 Dec 1974).

The values of the coupling constants (spectroscopic factors) dpn, ^{12}C^{11}Cn and ^{14}N^{13}Nn have been derived by means of the extrapolation of differential cross section data to the corresponding poles. Some general questions concerning the application of this method to light nuclei are considered. (auth)

24176 STUDY OF ANGULAR ASYMMETRIES IN THE ^{2}H (α, ^{3}He)^{3}H REACTION. Werby, M. F.; Robson, D. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Phys., A; 234: No. 2, 346-356(2 Dec 1974).

The Barshay—Temmer theorem predicts that the angular distribution of the products of the reaction ^{2}H(α, ^{3}He)^{3}H will be symmetric about 90° in the c.m. system. Recently, asymmetries were reported in the angular distribution in excess of 10% at some angles. These asymmetries clearly violate the theorem. In an effort to explain the asymmetry as well as describe the angular distribution an exact finite-range multi-interaction DWBA

calculation, which includes all appropriate one-particle-transfer reaction mechanisms, was employed. Semi-realistic three-nucleon wave functions were utilized in one case in deriving the form factors appropriate for two-particle clustering of the tri-nucleon systems, and various Coulomb effects associated with the interactions were included. It was found that both the asymmetry and angular distribution are well described within the present formalism. (auth)

24177 RADIATIVE PION CAPTURE IN ^{3}He. Phillips, A. C.; Roig, F. (Manchester Univ. (UK)). Nucl. Phys., A; 234: No. 2, 378-400(2 Dec 1974).

The rates for the radiative and charge-exchange capture of stopped pions in ^{3}He are calculated in the impulse approximation. The Panofsky ratio is considered in detail; the S,S', and D state components of the nuclear wave functions are included, and an estimate of the capture rate from a 2p state is made. It is shown that the recent experimental measurement of the Panofsky ratio by Truöl et al. implies that there are small corrections to the impulse approximation and that these corrections are similar in magnitude to those that occur in the related process, the β-decay of ^{3}H. The radiative breakup rates are calculated using the Amado model to describe the final states, and the results are compared with closure approximations. It is shown that each spin–isospin channel is dominated by the contribution of the state with the lowest threshold energy; that the impulse approximation can account for the experimental branching ratios and the shape of the photon spectrum; and that the radiative breakup reaction does not provide any evidence for the existence of a three-nucleon resonance. (auth)

24178 CROSS SECTION AND ANGULAR DISTRIBUTIONS FOR THE REACTION ^{4}He(γ,n)^{3}He. Irish, J. D. Toronto; Univ. of Toronto (1973). 98p.

Thesis.

The differential photoneutron cross section for ^{4}He was measured at a laboratory angle of 98° for excitation energies between 23 and 37 MeV using a ^{4}He gas target at a pressure of 51 atmospheres and with a liquid ^{4}He target at its normal boiling point for excitation energies between 22 and 32 MeV. Although each cross section individually agrees with previously published results, the two measured cross sections disagree with one another, the cross section values obtained with the gas target being approximately a factor of 1.9 greater than those obtained with the liquid target. The angular distribution of the photoneutrons was also measured by obtaining photoneutron energy spectra at 53, 68, 83, 98, 128, and 143°, using a liquid ^{4}He target. The angular distributions were consistent with the excitation being predominantly E1 followed by the emission of a p-wave neutron into a channel of channel spin zero. Evidence was seen for a small E2 intensity (~1% of the E1 intensity) in the excitation energy region below 27 MeV. It appears that the E2 strength increases somewhat above 27 MeV. The total cross section was inferred from the angular distribution coefficients and the 98° cross section obtained with the gas target. The values obtained for the cross section were used to obtain the values of the ratio $\sigma(\gamma,p)/\sigma(\gamma,n)$ in the region of the giant dipole resonance. (MGH)

24179 HARTREE–FOCK CALCULATIONS IN LIGHT NUCLEI WITH DENSITY DEPENDENT INTERACTIONS. Lassey, K. R. Hamilton, Ont.; McMaster Univ. (1973). 352p.

Thesis.

Hartree–Fock calculations were performed using several density dependent two-body effective interactions in structural calculations of light even–even, N = Z nuclei. Two distinct types of interactions were employed. The first are simple density and momentum dependent delta function interactions, of which several variants are derived to reproduce observed features in nuclear matter and in the nuclear surface and two of these are used in structural calculations. The second type of interaction has finite range criteria. Two representatives of this type are utilized. The calculations emphasize the important role played by the spin dependence of the interaction (the spin-orbit interaction), and the resemblance of the density distributions that result from the calculation to clusters of alpha particles. (auth)

24180 MEASUREMENT OF THE TRITIUM–BETA–SPECTRUM AND DETERMINATION OF THE ANTI-NEUTRINO REST MASS. Roede, B. (Heidelberg Univ. (F. R. Germany). Naturwissenschaftliche Gesamtfakultaet). 7 Jun 1972. 49p. (In German). INIS.

Available from the library of the Heidelberg Univ.

This work deals with the investigation of the super-allowed electronic beta decay of the ^{3}H nucleus (tritium), $^3H \rightarrow {}^3He + e^- + \bar{\nu}$, and the search for a smaller deviation from the lines in the Fermi plot presentation of the spectrum which occurs when the antineutrino released in the decay has a discrete rest mass. The following results were obtained: the decay energy of tritium was $E_0 = 18.649 \pm 0.074$ keV—and, with a confidence of 90%—$m_{\bar{\nu}} \leq 86$ eV. (GE)

24181 PHOTODISINTEGRATION OF ^{4}He. Wait, G. D. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1973). 137p.

Thesis.

Total and differential cross sections were measured for the reactions ^{4}He(γ,t)H from 32 MeV to 72 MeV excitation energy, ^{4}He(γ,^{3}He)n from 48 to 83 MeV and ^{4}He(γ,p)^{3}H from 23 to 35 MeV. A ^{4}He gas target was bombarded with 91.3 MeV electrons and all charged particles resulting from the breakup of ^{4}He were detected using a magnetic spectrometer and solid state detectors. The photodisintegration cross sections were obtained from the electrodisintegration cross sections and the virtual photon spectrum. The total cross sections agree well with previous experiments except at low energies where the contributions due to multiparticle final states were included in the measurement. The total photoneutron cross section is the same as the photoproton cross section, within experimental uncertainties, as expected from the dominance of E1 transitions. The proton angular distributions show a monotonic increase in forward peaking with increasing energy consistent with a relative increase in the E2 transitions. The neutron angular distribution is peaked backward at 48 MeV but becomes forward peaked above 53 MeV. This change in phase of the neutron asymmetry cannot be explained in terms of a simple E1–E2 interference. It is suggested that short range correlations might be important at higher excitation energies. The experimental data is compared with available theoretical calculations. (auth)

24182 PHOTODISINTEGRATION OF ^{3}He. Kundu, S. K. Saskatoon, Saskatchewan; Univ. of Saskatchewan (1972). 139p.

Thesis.

Total and differential cross sections for the reaction ^{3}He(γ,d)^{1}H were measured from 13 to 45 MeV in excitation using a magnetic spectrometer and solid state detectors. A detailed and systematic study of the energy and angular dependence of the cross section of the same reaction was also carried out. The reaction was studied by electrons rather than real photons and the measured cross section is converted to the equivalent photodisintegration cross section. To date most photodisintegration experiments on the ^{3}He nucleus were performed at one angle and/or at low energies. Existing data on the angular distributions of the process ^{3}He(γ,d)^{1}H are either statistically inaccurate with poor energy resolution or available only at few isolated energies. Moreover the total cross section inferred from the 90° differential cross section cannot be reconciled from the experimentally measured total cross section. The question of a bound excited state in the ^{3}He system is also inconclusive. These present experimental results are in good agreement with some of the previous experiments where the data overlap. The results show no inconsistency between the 90° differential cross section and the total cross section. The observed cross section, angular distribution and comparison with theory show that the final state interaction is quite important in the disintegration process. No structure in the cross section has been observed within experimental uncertainties. (MGH)

24183 NEUTRON–DEUTERON ELASTIC DIFFERENTIAL CROSS SECTION FROM 25.0 TO 55.0 MeV. Wang, J. C. Y. Davis, CA; Univ. of California (1974). 114p. University Microfilms Order No. 74-29,350.

Thesis (Ph. D.).

Differential cross sections for the elastic scattering of neutrons from deuterons were measured for the energies 26.5, 35.0, 46.3, and 53.0 MeV. For the three lowest energies, only the backward angles ($\theta_{cm} \geq 90$ deg.) were measured. At 35.0 and 46.3 MeV, corresponding proton–deuteron cross sections were measured by using the same experimental setup and electronics in order to better detect possible charge symmetry effects. At 53.0 MeV, a complete angular distribution was taken. The statistics of all points are between 1% to 3%. Absolute n–d differential cross sections of ≈ 5% precision were obtained by normalizing to precision n–p cross sections. These measurements show that, in the region of the minimum in the cross section, no large differences between n–d and p–d cross sections were detected. A phase-shift calculation of the p–d differential cross sections with and without the Coulomb force is in agreement with the experimental results. (Diss. Abstr. Int., B)

24184 REID SOFT–CORE POTENTIAL AND PARITY NONCONSERVING EFFECTS IN THERMAL–NEUTRON CAPTURE BY PROTONS. Lassey, K.R.; McKellar, B.H.J. (School of Physics, University of Melbourne, Parkville, Victoria, Australia 3052). Phys. Rev. C 11: No. 2, 349-351 (Feb 1975).

We report results of calculations of the parity–mixing observables in the capture of thermal neutrons by protons. The calculations are exact, and employ the Reid soft–core potential and the conventional Cabibbo

model potential to describe the strong and weak nucleon–nucleon interactions, respectively. The calculated photon circular polarization is -2×10^{-8}, which is two orders of magnitude less than the experimental value, but of the same sign. (auth)

24185 ATTENUATION AND p–p AND p–n QUASIFREE SCATTERING IN DEUTERON BREAKUP. Haracz, R.D.; Lim, T.K. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). Phys. Rev. C 11: No. 2, 634-636 (Feb 1975).

A new energy–dependent–core model for attenuation effects in quasifree scattering is used to explain the difference in quasifree scattering cross sections for the two kinematically equivalent modes of deuteron breakup under proton bombardment. (auth)

24186 HARMONIC OSCILLATOR STATES AND THE α PARTICLE. III. MATRIX ELEMENTS AND FORM FACTOR FOR STATES OF ARBITRARY SYMMETRY. Mendez–Moreno, R.M. (Facultad de Ciencias UNAM México); Seligman, T.H. Ann. Phys. (N.Y.) 88: No. 2, 397-418 (Dec 1974).

The methods proposed in previous papers for the treatment of a translationally invariant four-body problem in an oscillator basis are further developed. Particularly, the use of these methods for the calculation of two-body matrix elements and the elastic form factor with orbital functions adapted to permutational symmetry is investigated. Considerable simplifications are achieved and the usefulness of the method for large numerical calculations is greatly enhanced. By way of an example the groundstate of the α–particle and its elastic form factor are analyzed for central potentials. (auth)

24187 EFFECTS OF GROUND–STATE CORRELATIONS ON MUON CAPTURE MATRIX ELEMENTS. McCarthy, R.J.; Walker, G.E. (Department of Physics, Indiana University, Bloomington, Indiana 47401). Phys. Rev. C 11: No. 2, 383-392 (Feb 1975).

The muon capture matrix elements M_v^2, M_a^2, and M_p^2 are calculated for ^{4}He and ^{16}O using the closure approximation and utilizing the linked cluster expansion to introduce correlations in the nuclear target wave functions. An important set of diagrams is summed by replacing uncorrelated wave functions with Bethe–Goldstone wave functions. However, we also find it necessary to include diagrams insuring that the pair number operator is unchanged and (for ^{16}O) particle–hole diagrams to account for the fact that oscillator orbitals rather than Hartree–Fock orbitals are used for the uncorrelated basis. Typical results for ^{16}O are $M_v^{2(\mathrm{corr})} = 0.82M_v^{2(\mathrm{osc})} = 0.74M_p^{2(\mathrm{corr})} = 0.58M^{2(\mathrm{osc})}$, while for ^{4}He, $M_v^{2(\mathrm{corr})} = 0.88M_v^{2(\mathrm{osc})} = 0.78M_p^{2(\mathrm{corr})} = 0.76M^{2(\mathrm{osc})}$. The bulk of the effects arise from correlations induced by the tensor component of the nucleon–nucleon interaction. We find that including correlations reduces the predicted total capture rate by ~30% in ^{16}O and ~20% in ^{4}He. (auth)

24188 ANNIHILATION OF ANTI P IN TRITIUM AND BOUND STATES IN THE ANTI PN SYSTEM. Belyakov, A. V.; Dal'karov, O. D.; Orlov, Y. V. (Nuclear Physics Institute, Moscow State University). JETP Lett. (USSR) (Engl. Transl.); 20: No. 5, 153-154(5 Sep 1974).

It is shown that the spectrum of the recoil-deuteron momenta in the reaction of capture of stopped $\bar{p}$ in tritium, $\bar{p} + t \to d + (\bar{p}n) \to d + n\pi$, is sensitive to the contribution of higher partial waves ($l \geq 1$) in the $(\bar{p}n)$ system. These spectra are compared with the experimentally investigated spectrum of the recoil-proton momenta in the reaction $\bar{p} + d \to p + (\bar{p}n) \to p + n\pi$. (auth)

24189 MEASUREMENT OF THE ^{3}H-β SPECTRUM AND DETERMINATION OF AN UPPER LIMIT FOR THE ELECTRONIC ANTINEUTRINO REST MASS. Roede, B. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Naturforsch., 29A: No. 2, 261-274(Feb 1974). (In German).

The β spectrum of tritium has been measured with the Heidelberg $(\pi/2)\sqrt{13}$ high-resolution magnetic spectrometer. A new almost backscatter-free source technique and a special proportional counter were developed. Special attention is paid to the problem of energy losses of the electrons in the source layer to get a theoretical expression for correcting the measured spectra in a physically meaningful way. On the basis of the Wilcoxon rank test an upper limit of 86 eV at 90 percent confidence was obtained for the antineutrino rest mass. (auth)

24190 NON-ADDITIVE POTENTIAL IN THE He_3 SYSTEM WITHIN THE LCAO–MO–SCF APPROXIMATION. Gonzalez-Tovany, L. (Instituto Nacional de Energia Nuclear, Mexico City). Rev. Mex. Fis.; 23: No. 3, 301-318(Sep 1974).

The nonadditive three body potential of the He_3 system for general linear and triangular geometrical configurations is calculated by using the Polyatom program based on the Roothaan LCAO–MO–SCF method with a Gaussian basis set formed by 6 s-type and 3 p-type functions for each center. Tables and figures of numerical results are presented for linear, isosceles and scalene triangular configurations. A comparison with results of others is made. (auth)

24191 ANALYSIS OF THE PROTON–HELIUM SCATTERING AT 1 GeV. Rule, D.W.; Hahn, Y. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. Lett. 34: No. 6, 332-335 (10 Feb 1975).

The proton–helium elastic scattering data at 1 GeV are analyzed using the effective–channel approach. The calculated spin–averaged cross section is in good agreement with the experiment from Saclay up to 35 deg, effectively with no free adjustable parameters. An estimate for the average excitation energy and for the ratio $Re f / Im f$ of the nucleon amplitude is obtained. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 23976, 24072, 24175, 24179, 24187, 24221, 24229, 24230, 24236, 24255, 24262, 24272, 24295, and 24361.

24192 (CEA-CONF-2770) HOLE STRENGTH DISTRIBUTIONS FROM (e,e'p) REACTIONS. Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Priou, M.; Royer, D.; Sick, I.; Wagner, G. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 1974. 4p. (CONF-740934-6). Dep. NTIS (US Sales Only) $4.00.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

The results of a DWIA analysis of (e,e'p) experiments on carbon-12, silicon-28, calcium-40, and nickel-58 at 500 MeV are presented. Together with extraction of occupation numbers, mean removal energies, and mean kinetic energies in an independent-particle model for the target nucleus, a more general sum rule was used to obtain a quantitative test of a shell model description of nuclei. (JFP)

24193 (CONF-730660-P2, pp B163-B189) DESCRIPTION OF LIGHT NUCLEI IN BARGMANN HILBERT SPACE. Kramer, P. (Univ., Tuebingen, Ger.). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The description of light nuclei in Bargmann Hilbert space covers linear canonical transformations in a Hilbert space of entire analytic functions introduced by Bargmann and some models of nuclear structure in order to apply canonical transformations. A unified viewpoint on the two-center and oscillator cluster model. The ground state of lithium 6 is discussed along these lines. Exchange integrals are derived in terms of complex canonical transformations. These considerations may be considered as a first step towards an investigation of the cluster model in Bargmann Hilbert space. (JFP)

24194 (CONF-730660-P2, pp B210-B231) DETERMINATION OF ISOSCALAR MAGNETIC MOMENT GAMOW–TELLER MATRIX ELEMENT AND SPIN–ORBIT COUPLING PARAMETER FOR A = 12 NUCLEI. Pham, T. N. (Centre de Physique Theorique de l'Ecole Polytechnique, Paris). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The absence of M1 transitions from the ground to highly excited 1^+ states other than the well known 1^+ states of ^{12}C was used to derive the following results in good agreement with experiment: $\mu(^{12}B) + \mu(^{12}N) = 1.38\ \mu_N$; $|\int \sigma|^2_{E_N=12.71} = 1$ and effective spin-orbit coupling parameter $a = 4.5$ MeV by means of sum rule technique. This shows that the well known 1^+ states can be assigned an almost pure (L = 1, S = 1) component of the (110) Wigner supermultiplet. (auth)

24195 (JINR-P15-7650) ANALYSIS OF THE CROSS-SECTIONS OF THE REACTION ^{3}He,p) ON ^{12}C BY THE RESONANCE THEORY. Shirmer, G.; Krivopustov, M. I.; Shul'ts, G.; Ehler, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 21p. (In Russian). INIS.

Differential cross sections of the reaction $^{12}C(^3He,p)^{14}Li$ are analyzed according to resonance theory in the energy region from 2.20 to 3.61 MeV. First the spins and parities of the three resonances were determined. More accurate values were obtained for the energies and total widths of the resonance states of the compound nucleus ^{15}O. The existence of a $\frac{1}{2}^-$ resonance at an energy of 2.87 MeV was confirmed. (10 refs.) (tr-SJR)

24196 (LAP-126) NEW METHOD FOR MEASUREMENT OF PROTON ENERGIES. Rolfs, C.; Rodney, W. S.; Durrance, S.; Winkler, H. (California Inst. of Tech., Pasadena (USA); California State Univ., Los Angeles (USA)). Jun 1974. 25p. Dep. NTIS $4.25.

A convenient and precise method of measuring proton beam energies was developed which uses the nonresonant direct-capture reaction $^{16}O(p,\gamma)^{17}F$. The method makes use of the resulting γ rays whose energies lie near the energy of the proton beam. These γ rays can be observed easily for proton energies above 800 keV. A comparison of the energies of these γ rays with precisely known energies of γ rays from radioactive sources enables one to measure the beam energy to a precision of about ±270 eV. The method was applied to determine the Q value of the $^{17}O(p,\gamma)^{18}F$ reaction: Q = 5605.51 ± 0.33 keV. (auth)

24197 SELECTIVITY OF THE $^{16}O(^7Li,\alpha)$ REACTION AND STATES WITH $(sd)^3$ AND $(sd)^2(fp)^1$ CONFIGURATIONS IN ^{19}F. Tserruya, I.; Rosner, B. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics); Bethge, K. (Heidelberg Univ. (F.R. Germany). 2. Physikalisches Inst.). Nucl. Phys., A; 235: No. 1, 75-81 (9 Dec 1974).

The $^{16}O(^7Li,\alpha)^{19}F$ reaction has been studied at 35 MeV up to 11 MeV excitation energy. Comparison with the $^{16}O(^6Li,\ ^3He)^{19}F$ and $^{16}O(^6Li,t)^{19}Ne$ reactions shows very good agreement up to 5.5 MeV excitation energy and large differences at higher excitation energies, which can be explained by different angular momentum matching conditions in the different reactions. The identification of mirror states in A = 19 and of states with $(sd)^3$ and $(sd)^2$ $(fp)^1$ configurations in ^{19}F are discussed. (auth)

24198 MICROSCOPIC CALCULATIONS FOR THE TWO $5/2^-$ RESONANCES OF THE NUCLEI ^7Li AND ^7Be. Teufel, A. G. (Tuebingen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 235: No. 1, 19-26(9 Dec 1974).

Calculations for the two $5/2^-$ resonances of the mirror nuclei ^7Li and ^7Be are performed within the framework of cluster representations of nuclei. By using the same microscopic forces for both nuclei, their phase-shift and resonance width differences in the energy region of the $5/2^-$ resonances are shown to be mainly due to effects produced by the Coulomb interaction. (auth)

24199 PROTON CAPTURE BY ^{15}N AT STELLAR ENERGIES. Rolfs, C.; Rodney, W. S. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 235: No. 2, 450-459(16 Dec 1974).

Excitation functions of the $^{15}N(p,\gamma)^{16}O$ proton capture reaction have been obtained at $\theta_\gamma = 45°$ and $E_p = 150-2500$ keV. Below $E_p = 400$ keV, the reaction is dominated by capture into the ground state of ^{16}O. The observed excitation function for the latter process can be explained if, in addition to the two well-known $J^\pi = 1^-$ resonances at $E_p = 338$ and 1028 keV, a direct radiative capture process (DC → 0) is included in the analysis. The direct capture component in the capture reaction is enhanced through interference effects on the tails of the two resonances. From the observed direct capture cross section, a single-particle spectroscopic factor of $C^2S(1p) = 1.8 \pm 0.4$ has been deduced for the ground state in ^{16}O. The extrapolated astrophysical S-factor of $S(0) = 64 \pm 6$ keV · b for the $^{15}N(p,\gamma_0)^{16}O$ reaction is a factor of 2.5 larger than previously reported. This result amplifies the role of the oxygen side cycle in the CNO hydrogen burning process. The observed excitation function of the $^{15}N(p,\alpha_1\gamma_1)^{12}C$ reaction at $E_p = 150-2500$ keV shows that this reaction makes a negligible contribution to hydrogen burning at stellar energies [S(0) ~ 0.1 keV · b] compared to $^{15}N(p,\gamma_0)^{16}O$ and $^{15}N(p,\alpha_0)^{12}C$. (auth)

24200 R-MATRIX ANALYSIS OF THE $^{12}C(\alpha,\gamma)^{16}O$ REACTION. Weisser, D. C.; Morgan, J. F.; Thompson, D. R. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 235: No. 2, 460-469(16 Dec 1974).

The problems involved in extrapolating the $^{12}C(\alpha,\gamma)^{16}O$ cross section to stellar energies are investigated. In the R-matrix formalism used, the extrapolated cross section is shown to be approximately independent of the interaction radius and the boundary condition number. Simultaneously good fits to recent $^{12}C(\alpha,\gamma)^{16}O$ data and the $^{12}C + \alpha$ elastic scattering p-wave phase shift are shown. (auth)

24201 THE MAGNETIC MOMENT OF THE 4^+, 3.55 MeV LEVEL OF ^{16}O. Berant, Z.; Broude, C.; Dima, S.; Goldring, G.; Hass, M.; Shkedi, Z.; Start, D. F. H.; Wolfson, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Nucl. Phys., A; 235: No. 2, 410-416(16 Dec 1974).

The magnetic moment of the 4^+, 3.55 MeV level of ^{16}O has been determined to be $|g| = 0.62 \pm 0.10$ in a perturbed angular correlation measurement on nuclei recoiling into gas and vacuum. Analysis of the recoil-into-gas data using the Abragam-Pound model agrees with analysis of the recoil-into-vacuum data using a model for the electronic ensemble described in a previous communication. The value of the g-factor shows the 4^+ wave function to consist mainly of the $d_{\frac{5}{2}}$ configuration. (auth)

24202 GAMMA-RAY ENERGIES FROM $^{14}N(n,\gamma)^{15}N$ AND $^{23}Na(n,\gamma)^{24}Na$ REACTIONS: A RE-EVALUATION. Greenwood, R. C.; Helmer, R. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nucl. Instrum. Methods; 121: No. 2, 385-389(15 Oct 1974).

Previous values reported for the energies of the prompt γ-rays resulting from thermal neutron capture in ^{14}N and ^{23}Na have been revised to provide greater accuracy by renormalizing them to an atomic mass-based scale. This atomic mass scale is defined here by a value of (10833.64 ± 0.13) keV for the neutron binding energy, $B_N(^{15}N)$, of ^{15}N, which has been computed utilizing the precise value of the $^{14}N^2H-^{15}N^1H$ mass difference measured by Kerr and Bainbridge, the mass-energy conversion factor and an average value of $B_N(^2H)$. The revised transition energies in ^{15}N were obtained from a least-squares adjustment of the older data, after first increasing those energies by 32.2 ppm to be consistent with the atomic mass scale. From spectra which had been measured using a mixed nitrogen and sodium sample the energy differences between closely spaced lines which resulted from the $^{14}N(n,\gamma)$ and $^{23}Na(n,\gamma)$ reactions were determined. In this way, energies were obtained for two of the higher-energy prompt γ-ray transitions resulting from thermal neutron capture in ^{23}Na. By using these transition energies in a least-squares adjustment an energy of (6959.41 ± 0.12) keV was obtained for the thermal-neutron-capturing state energy of ^{24}Na, that is for $B_N(^{24}Na)$. (auth)

24203 THE ^{12}C NUCLEUS AS A 3α SYSTEM WITH FORBIDDEN STATES. Smirnov, Yu. F.; Obukhovsky, I. T.; Tchuvil'sky, Yu. M.; Neudatchin, V. G. (Moskovskij Gosudarstvennyj Univ. (USSR). Inst. Yadernoj Fiziki). Nucl. Phys., A; 235: No. 2, 289-298(16 Dec 1974).

The 0_1^+ ground state and the 0_2^+ and 0_3^+ first excited states of ^{12}C have been calculated in the model of three α-particles whose interaction is described by using a local attractive potential with forbidden states, which reproduces well the $\alpha-\alpha$ scattering phases. The methods of projection of the states forbidden by the Pauli exclusion principle in a system of three composite particles are discussed. The results of the calculation show that the condition of orthogonality to the forbidden states is sufficient to prevent the system from collapse. The binding energy value obtained (15.06 MeV) is somewhat overestimated. This discrepancy seems to come from neglecting triple exchanges of nucleons of different α-particles and from the fact that the ^{12}C real nucleus differs from the 3α system. (auth)

24204 STUDY OF THE MECHANISM OF THE RADIATIVE CAPTURE OF LOW ENERGY NUCLEONS BY ^{12}C. Johnson, D. L. Seattle; Univ. of Washington (1974). 243p. University Microfilms Order No. 74-29,434.

Thesis (Ph. D.).

The mechanism of the $^{12}C(p,\gamma_0)^{13}N$ radiative capture reaction at low energies was investigated. The excitation function at 90° was measured in an energy region ($2.7 \lesssim E_p \lesssim 9$ MeV) where three previous experimenters had not succeeded. The observed excitation function displays interesting structure which might be described in terms of only a few resonant states plus a contribution from the so-called direct capture of protons from the continuum. It is shown that both the shape and magnitude of most of the measured excitation function are well reproduced with a simple E1 capture model involving only direct capture plus capture involving intermediate compound states which include configurations where the 2^+ first excited state of ^{12}C is coupled to an extra nucleon. The calculation makes use of incident wave functions generated with a coupled-channels calculation which has previously been shown to reproduce the data for the scattering of low-energy nucleons by ^{12}C. The model was also applied to the $^{13}C(\gamma,n_0)^{12}C$ reaction, which is related to its inverse, the neutron capture reaction, by detailed balance. Here, too, the implications of the model compare fairly well with measurements which include some angular distribution information. (Diss. Abstr. Int., B)

24205 HELIUM PRODUCTION CROSS SECTION OF BORON FOR FAST-REACTOR NEUTRON SPECTRA. Farrar, H. IV (Rockwell International Corp., Canoga Park, CA); McElroy, W. N.; Lippincott, E. P. Nucl. Technol.; 25: No. 2, 305-329 (Feb 1975).

Measurements were made of the helium generated by (n,α) reactions in boron that have resulted from several fast-neutron irradiations in the Experimental Breeder Reactor II (EBR-II) and the Coupled Fast Reactivity Measurements Facility (CFRMF). The neutron environments were characterized by using multiple-foil dosimetry and reactor physics calculations. Precise helium determinations of boron specimens in milligram size were made by using a high-sensitivity-gas mass spectrometer system specifically designed for this purpose. Spectrum-integrated helium-production cross sections were determined from the measured

helium concentration data and the experimentally measured values of total neutron flux. Good consistency was found between the measured reaction rates of ^{10}B and ^{235}U. In the case of certain other dosimetry foils where cross sections are less accurately known, inconsistencies of up to 30% in predicted reaction rates have been found in EBR-II neutron spectra perturbed by the presence of B_4C. This indicates that the $^{10}B(n,\alpha)^7Li$ reaction is a very useful addition to multiple-foil dosimetry sets, and that its use will help to establish more accurate cross-section data for other foil reactions. (auth)

24206 INTERACTIONS OF CHARGED COSMIC RAY HADRONS OF ENERGY GREATER THAN 70 GeV IN A CARBON TARGET. Wilkes, R. J. Madison, WI; Univ. of Wisconsin (1974). 134p. University Microfilms Order No. 74-19,589.
Thesis (Ph. D.).

Interactions of charged cosmic-ray hadrons in a carbon target (thickness 17.4 g/cm^2) were observed at Echo Lake, Colorado (alt. 3231 m), by using wide-gap optical spark chambers and an ionization calorimeter. Interaction products were observed in a spark chamber which contained a lead plate (7.2 g/cm^2 thick) to materialize the photons resulting from the decay of neutral secondaries. Results are presented on charged multiplicity distributions, angular distributions, and the neutral-to-charged ratio of secondaries for primary energies above 70 GeV. The results are discussed in the context of current theoretical conjecture. (Diss. Abstr. Int., B)

24207 ELECTROMAGNETIC DECAY OF THE 7.65-MeV AND 9.64-MeV STATES OF ^{12}C. Chamberlin, D. D. Seattle; Univ. of Washington (1974). 104p. University Microfilms Order No. 74-29,387.
Thesis (Ph. D.).

A measurement was made of the branching ratio, Γ_{rad}/Γ, for electromagnetic transitions from the 7.65-MeV state of ^{12}C. This ratio is of particular interest in that the rate of ^{12}C synthesis in stellar helium burning is proportional to Γ_{rad}. The 7.65-MeV state was excited by inelastic scattering of 24-MeV alpha particles on ^{12}C, and electromagnetic transitions were identified by detecting coincidences between the inelastic alpha particles and the associated ^{12}C ions remaining after gamma ray or electron pair emission. It was found that $\Gamma_{rad}/\Gamma = (4.2 \pm 0.2) \times 10^{-4}$, which may be compared to the previous best value of $(2.9 \pm 0.3) \times 10^{-4}$. The new result, combined with available information on the width and branching ratio for electron pair emission, leads to a radiative width $\Gamma_{rad} = \Gamma_\gamma + \Gamma_{e\pm} = (3.9 \pm 1.2)$ MeV. A similar experimental study was carried out for the 9.64-MeV state of ^{12}C, which may play a role in helium burning at very high temperatures ($\geq 7 \times 10^9$K). At a confidence level corresponding to one standard deviation, an upper limit on Γ_{rad}/Γ was found to be 4.1×10^{-7}; while at a 95% confidence level, the upper limit is $\Gamma_{rad}/\Gamma = 8.2 \times 10^{-7}$. These results, combined with the known total width, Γ, of the state, give upper limits on the radiative width, Γ_{rad}, of 14 MeV and 28 MeV, at the respective confidence levels. These limits encompass the value of $\Gamma_{rad} = 10$ MeV, commonly assumed in current astrophysical model calculations, and rule out the possibility of much higher values for Γ_{rad} which otherwise could not be conclusively rejected. (Diss. Abstr. Int., B)

24208 PRODUCTION OF ^6Li, ^9Be, AND ^{10}B IN p + ^{13}C REACTIONS FROM THRESHOLD TO 18 MeV. Oberg, D. L. Seattle; Univ. of Washington (1974). 125p. University Microfilms Order No. 74-29,472.
Thesis (Ph. D.).

Total cross sections for the production of the light elements ^6Li, ^9Be and ^{10}B from p + ^{13}C reactions were measured from near threshold to 18 MeV. This work was motivated by an interest in the possible role of these reactions in the production of the light elements in stars or in the interstellar medium. Excitation functions at two angles were taken with 100 keV steps to follow the trend of the yields. Angular distributions were taken at a number of incident energies. Much of the structure of the ^{10}B data can be identified with compound nuclear resonances in ^{14}N. A sharp minimum in the 1.74-MeV state excitation function at $E_p = 14.15$ MeV is thought to be due to the presence of a T = 1 state near an excitation energy of 21 MeV in ^{14}N, and structures near $E_p = 11.4$ MeV were tentatively identified with isospin mixed states seen in the isospin forbidden $^{12}C(d,\alpha)\ ^{10}B(1.74)$ reaction. Ratios of light element yields as a function of proton energy were calculated by combining the present cross sections with the cross sections for other CNO nuclei, taken in proportion to their observed abundances. It is concluded that these ratios could be fit using an appropriately weighted proton spectrum in the region below 25 MeV, with ^{12}C, ^{14}N, ^{16}O, and, very importantly, ^{13}C present with relative abundances roughly equal to those in the solar system. (RWR)

24209 HIGH-SPIN STATES IN ^{23}N. Frank, G. G. Hamilton, Ont.; McMaster Univ. (1973). 101p.
Thesis.

The $^{12}C(^{12}C,p\gamma)^{23}Na$ reaction was used to study the γ-ray deexcitation of levels up to $E_x = 10.4$ MeV in ^{23}Na. Branching ratios were obtained for the 5.54, 6.11, 6.24 and 6.35 MeV levels and the major modes of decay were observed for 7 levels above $E_x = 7$ MeV. Doppler-shift attenuation measurements yielded mean lifetimes or lifetime limits for 22 levels in ^{23}Na. Angular distributions were measured for γ rays in coincidence with proton groups corresponding to the 5.54, 6.11, 6.24, 6.35, 9.04 and 10.35 MeV levels. The 6.35 level is assigned a spin and parity of $5/2^-$ and interpreted as a member of the low lying $K^\pi = 1/2^-$ band in ^{23}Na. The 5.54 and 6.24 MeV levels are shown to have positive parity and are interpreted as the $11/2^+$ and $13/2^+$ members of the ground-state band, respectively. The highly populated levels at 9.04 and 10.35 MeV are interpreted as the $15/2^+$ and $13/2^-$ members of the ground-state band and $K^\pi = 1/2^-$ band, respectively. The experimental γ-ray transition strengths in ^{23}Na are compared with those predicted by the Nilsson model including band mixing and a modification to the M1 strengths to account for the effects of isospin. (auth)

24210 PROTON STATES OF DEFORMED NUCLEI WITH A = 153 TO A = 163. Tippett, J. C. Hamilton, Ont.; McMaster Univ. (1973). 138p.
Thesis.

Proton states of ^{153}Eu, ^{155}Eu, ^{155}Tb, ^{157}Tb, ^{159}Tb, ^{161}Tb and ^{163}Ho were studied using the (α,t) and $(^3He,d)$ reactions. Beams of 24-MeV ^3He and 25-MeV alpha particles were produced by the McMaster University model FN tandem Van de Graaff accelerator. The reaction products were analyzed with an Enge split-pole magnetic spectrograph and detected with photographic emulsions. Ratios of the cross sections between the (α,t) and $(^3He,d)$ reactions were used as an indication of the l-values for the proton transfers, and the spectroscopic factors were extracted using DWBA calculations. Interpretation of the results is made in terms of the unified model. (MGH)

24211 NUCLEAR STRUCTURE OF ^{19}F. Rogers, D. Toronto; Univ. of Toronto (1972). 256p.
Thesis.

All known data from gamma-ray spectroscopy studies of the 26 levels below 6.2 MeV excitation in ^{19}F and from 6 levels above this energy are critically reviewed, summarized and presented as tables of transition strengths. Most of the positive parity states are shown to be well described by an $(sd)^3$ shell model calculation using the Kallio-Koltveit residual interaction, and attention is drawn to levels which do not fit this description. The negative parity states outside the $K = 1/2^-$ band are shown to require more configurations in the shell model calculations than considered in weak coupling calculations. (auth)

24212 DISTORTED WAVE ANALYSIS OF THE $^{17}O(t,p)^{19}O$ REACTION. Crozier, D.J.; Fortune, H.T.; Middleton, R. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Wiza, J.L. Phys. Rev. C 11: No. 2, 393-400 (Feb 1975).

The angular distributions of $^{17}O(t,p)^{19}O$ transitions to 13 states in ^{19}O have been analyzed by distorted-wave techniques. Two-particle transfer amplitudes from recent $(sd)^3$ shell-model calculations have been utilized to aid in the interpretation of the structure of ^{19}O. The theoretical calculations reproduce the L admixtures in the angular distributions remarkably well for many of the low-lying states. Ratios of measured-to-predicted cross sections are consistent to within a factor of 3. The correspondence between the experimentally known states of ^{19}O and those predicted by the shell-model calculations is discussed; most of the states with known J^π are well accounted for. (auth)

24213 CROSS SECTIONS FOR THE $^7Li(d,p)^8Li$, $^6Li(^3He,n)^8B$, $^6Li(d,\alpha)^4He$, $^6Li(d,p)^7Li$, AND $^6Li(d,n)^7Be$ REACTIONS. McClenahan, C.R.; Segel, R.E. (Northwestern University, Evanston, Illinois 60201 and Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 11: No. 2, 370-382 (Feb 1975).

The $^7Li(d,p)^8Li$, $^6Li(^3He,n)^8B$, $^6Li(d,\alpha)^4He$, $^6Li(d,p)^7Li$, and $^6Li(d,n)^7Be$ reactions have been studied, chiefly at bombarding energies below 3.8 MeV. All five of these reactions have potential applications in controlled thermonuclear systems. Total cross sections, believed to be accurate to 15%, which is sufficient for reactor design, have been determined in all cases. Residual activity was counted in the $^7Li(d,p)$ and $^6Li(^3He,n)$ studies, while the yield of the ^7Be 428-keV γ ray was measured in the $^6Li(d,n)$ investigation. Extensive angular distribution measurements were made for the $^6Li(d,\alpha)$ and $^6Li(d,p)$ reactions, and some discussion is given of the reaction mechanisms. Wherever possible, detailed comparisons are given to previously reported results. (auth)

24214 EXPERIMENTAL EVIDENCE FOR A TWO-STEP PROCESS IN THE REACTION $^{19}F(^{16}O,\ ^{15}N)^{20}Ne$. Pougheon, F.;

Rotbard, G.; Roussel, P.; Vernotte, J. (Institut de Physique Nucléaire, Université Paris–Sud, 91406 Orsay, France). Phys. Rev. Lett. 34: No. 3, 158-160 (20 Jan 1975).

A strong population of the "j–forbidden" 4^+ level at 4.25 MeV in ^{20}Ne is found in the reaction ^{19}F(^{16}O, ^{15}N)^{20}Ne at 46–, 58–, and 68–MeV incident energy. It provides evidence for a two–step process. This result was expected for structural and kinematical reasons. (auth)

24215 COMPARISON OF THE ^{16}N^m(0$^-$) β-DECAY RATE WITH THE INVERSE MUON-CAPTURE RATE: THE INDUCED PSEUDOSCALAR FORM FACTOR IN NUCLEI. Palffy, L.; Deutsch, J. P.; Grenacs, L.; Lehmann, J.; Steels, M. (Institut de Physique Corpusculaire, Universite Catholique de Louvain, Louvain-la-Neuve, Belgium). Phys. Rev. Lett.; 34: No. 4, 212-215(27 Jan 1975).

We report on the observation of the ^{16}N^m(0$^-$) $\rightarrow$ ^{16}O(g.s.) β decay. The comparison of the measured decay rate, 0.43 ± 0.10 sec^{-1}, with the rate of the inverse muon-capture reaction in ^{16}O yields for the induced-pseudoscalar form factor $13 \leq g_p(q^2 \simeq m_\mu^2) \leq 20$. Subject to the approximations of the analysis and neglecting possible second-class currents, this result indicates an upward renormalization of this form factor in nuclei. (auth)

24216 SPIN AND PARITY OF THE 3.52–MeV STATE OF ^{16}N. Fortune, H.T. (Argonne National Laboratory, Argonne, Illinois 60439 and Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Medsker, L.R.; Bishop, J.N.; Headley, S.C. Phys. Rev. C 11: No. 2, 304-307 (Feb 1975).

For the 3.520–MeV state of ^{16}N, a comparison of ^{15}N(d, p)^{16}N and ^{15}N(n, n)^{15}N results strongly suggests a spin–parity of 1^- or 2^+. (auth)

24217 PRODUCTION OF ^{6}Li, ^{9}Be, AND ^{10}B IN p + ^{13}C REACTIONS AT LOW ENERGIES. Oberg, D.L.; Bodansky, D.; Chamberlin, D.; Jacobs, W.W. (Department of Physics, University of Washington, Seattle, Washington 98195). Phys. Rev. C 11: No. 2, 410-419 (Feb 1975).

Cross sections have been measured for the production of ^{6}Li, ^{9}Be, and ^{10}B in proton reactions on ^{13}C, at energies extending from threshold to 18 MeV. The reaction products were identified by time–of–flight techniques, and total cross sections were determined by integrating over the measured angular distributions. Although the typical abundance of ^{13}C in nature is small compared to that of ^{12}C, ^{14}N, or ^{16}O, the ^{13}C reactions may have a significant role in the production of the light elements because of their low Q values. Even for a ^{13}C/^{12}C ratio as low as the terrestial ratio of 0.01, the inclusion of ^{13}C contributions is found to reduce appreciably the 7/6, 11/10, and Li/Be abundance ratios calculated for interactions at low energies between protons and a representative mixture of C, N, and O. Over–all, this reduction brings the abundance ratios calculated at proton energies below 25 MeV closer to the observed solar system ratios. (auth)

24218 HIGH–SPIN STATES IN ^{20}Ne REACHED BY ^{16}O(α, α)^{16}O ELASTIC SCATTERING. Ceuleneer, R.; Michel, F. (Faculté des Sciences, Université de l'Etat, B–7000 Mons, Belgium); Bosman, M.; Lega, J.; Leleux, P.; Macq, P.C.; Meulders, J.P.; Pirart, C. Phys. Rev. C 11: No. 2, 631-633 (Feb 1975).

The ^{16}O(α, α)^{16}O excitation curve has been measured at 177.9 ° center of mass between 12.8 and 14.8 MeV incident energy with an energy resolution of 90 keV. Angular distributions taken at three resonance energies have been analyzed by a one–Regge–pole model: The 7^- spin of the 15.41-MeV level in ^{20}Ne is confirmed, and two new 6^+ levels are found at 15.72 and 15.97 MeV in ^{20}Ne. (auth)

24219 3^+ STATE AT 9.13 MeV IN ^{14}N. Fortune, H.T.; Bingham, H.G.; Crozier, D.J.; Bishop, J.N. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 11: No. 2, 302-303 (Feb 1975).

An $L = 0$ component observed in the angular distribution of the ^{10}B(^{6}Li, d)^{14}N reaction leading to a state at 9.13 MeV in ^{14}N assigns $J^\pi = 3^+$ to this level. This presumably is the "missing" 3^+ state predicted by Lie but previously unidentified. (auth)

24220 ELECTROEXCITATION OF ^{11}B. Kan, P.T.; Peterson, G.A.; Webb, D.V. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Fivozinsky, S.P.; Lightbody, J.W. Jr.; Penner, S. Phys. Rev. C 11: No. 2, 323-331 (Feb 1975).

Electrons with incident energies between 52.3 and 90.0 MeV have been scattered from the nucleus of ^{11}B. Spectra of scattered electrons corresponding to excitation energies up to 32 MeV were observed at angles of 75° and 145°. Form factors of the states at 2.12, 4.44, 5.02, 8.57, and 8.93 MeV, and of the continuum region up to 30 MeV, have been separated into longitudinal and transverse components. The ^{11}B dipole giant resonance is smooth relative to those of ^{12}C and ^{13}C. A mixed $M1-E2$ transition was observed at 13.0 MeV; and a broad transverse resonance, possibly magnetic, was seen at 15.5 MeV. (auth)

24221 DISTORTED-WAVE ANALYSIS OF THE ^{14}N(t,p)^{16}N REACTION. Crozier, D. J.; Fortune, H. T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev., C; 11: No. 2, 308-315(Feb 1975).

Angular distributions from the ^{14}N(t,p)^{16}N reaction have been analyzed using distorted-wave-techniques and employing two-particle-transfer amplitudes from a recent $1p_{\frac{1}{2}}-1d_{\frac{5}{2}}-2s_{\frac{1}{2}}$ shell-model calculation. Ten experimental levels in ^{16}N can be identified with shell-model counterparts. Restrictions are placed on the spin and parity assignments of several of the remaining states. (auth)

24222 (π^+, pp) REACTION ON SEVERAL LIGHT NUCLEI. Arthur, E.D. (University of Virginia, Charlottesville, Virginia 22901); Lam, W.C.; Amato, J.; Axen, D.; Burman, R.L.; Fessenden, P.; Macek, R.; Oostens, J.; Shlaer, W.; Sobottka, S.; Salomon, M.; Swenson, W. Phys. Rev. C 11: No. 2, 332-348 (Feb 1975).

The (π^+,2p) reaction has been studied on targets of ^{2}H, ^{6}Li, ^{14}N, and ^{16}O with 70–MeV pions. All kinematical quantities needed to define completely the final state were determined. The data are presented in an unbiased form, integrated over well–defined regions in phase space, and are thus readily comparable with available theoretical calculations. Data were obtained for opening angles both on and off the kinematics of the free process, $\pi^+ + d \rightarrow p + p$. Thus a more extensive test of the applicability of a pole model or impulse approximation which assumes absorption on a quasideuteron could be made. For ^{6}Li and ^{16}O the center of mass angular distribution was determined and compared with that for π^+ absorption on a free deuteron. Nuclear structure effects appear to play an important role for capture on ^{16}O and ^{14}N, since little excitation of the low–lying levels of the residual nuclei was observed, in contrast to theoretical predictions. For events leading to low excitation of the residual nucleus, theoretical curves in recoil and relative momentum, Treiman–Yang angle, and opening angle calculated for a pole model or plane wave impulse approximation gave general agreement with the measured distributions even for events off the kinematics of the free πd process. (auth)

24223 COUPLED–CHANNELS CALCULATION OF THE ANALYZING POWER IN THE REACTION ^{15}N($\vec{p}$, γ_0)^{16}O USING POLARIZED PROTONS. Ramavataram, K.; Rao, C.L.; Ramavataram, S. (Département de Physique et Laboratoire de Physique Nucléaire, Université Laval, Québec 10, Canada). Phys. Rev. C 11: No. 2, 450-456 (Feb 1975).

The excitation function of the analyzing power A (θ) in the reaction ^{15}N($\vec{p}$, γ_0)^{16}O induced by polarized protons is calculated by the coupled–channels theory and compared with experiment. The theory predicts (i) the minimum in the value of A (45°) corresponding to the observed minimum at 7.8 MeV proton energy and (ii) the sign and magnitude of A (45°) in the region of the giant dipole resonance in ^{16}O. This theoretical analysis shows that the structure in A (45°) can be directly related to the configuration of the 1^- states below the giant dipole resonance. (auth)

24224 (p, pd) REACTION ON ^{6}Li AT 590 MeV FOR HIGH RECOIL MOMENTA. Kitching, P.; Olsen, W.C.; Sherif, H.S. (Nuclear Research Centre, University of Alberta, Edmonton, Canada); Dollhopf, W.; Lunke, C.; Perdrisat, C.F.; Priest, J.R.; Roberts, W.K. Phys. Rev. C 11: No. 2, 420-425 (Feb 1975).

In a kinematically complete experiment with 590-MeV protons, the reaction ^{6}Li(p, pd) has been studied for recoil momenta up to 240 MeV/c. When the results are interpreted in terms of the plane-wave impulse approximation, it is found that the number of α–d clusters in ^{6}Li is 0.78 $\pm$ 0.10. If the momentum distribution is fitted with a Gaussian of the form $e^{-(q/q_0)^2}$, the best fit is obtained with a width parameter $q_0 = 73 \pm 1.6$ MeV/c, in agreement with our previous results at lower recoil momenta. Several model wave functions were used to calculate the momentum distribution. Qualitative agreement is obtained, with the best fit being provided by the Eckart-type cluster wave function. (auth)

24225 ENERGY SPECTRUM MEASUREMENT OF THE DECAY ^{16}N–(β^-) $\rightarrow$ ^{16}O* $\rightarrow$ α + ^{12}C; FITTING TO A ONE-LEVEL SCHEME. Dietz, J. (Mainz Univ. (F. R. Germany). Naturwissenschaftliche Fakultaet). 29 Jun 1972. 78p. (In German). INIS.

The energy spectrum of ^{12}C + α for the decay named in the title has been measured. Besides the dominating ^{16}O(9.597) resonance, the first-forbidden beta transition ^{16}N(2^-)–(β^-) $\rightarrow$ ^{16}O(2^+; 9.847 MeV) $\rightarrow$ α + ^{12}C is detected. The reduced lifetime is found to be $f_0 t_{\frac{1}{2}} = (5.1 \pm 1.9) \times 10^8$ sec. The spectrum of the ^{16}O* decay can be very well reproduced by a one-level scheme with 4 parameters. (GE)

24226 MEASUREMENTS OF THE ^{6}Li(n,α)T CROSS SECTION IN THE keV ENERGY RANGE. Poenitz, W. P. (Argonne National Lab., Ill. (USA)). Z. Phys.; 268: No. 4, 359-364(Jul 1974).

The ^{6}Li(n,α) cross section was measured in the 90–1,500 keV energy range with uncertainties of 3–5%. A lithium glass scintillation detector was used for the measurement of the (n,α) reaction rate. Flat response neutron detectors were used to monitor the neutron flux. A calibrated vanadium bath was employed to obtain

absolute values. The results were analyzed in terms of the single-level multichannel R-matrix theory. (auth)

24227 POLARIZATION AND ANGULAR DISTRIBUTION OF NEUTRONS FROM THE REACTION $^{13}C(^3He,n_0)^{15}O$. Efken, B. (Freie Univ. Berlin (F. R. Germany). Fachbereich Physik). 24 Aug 1971. 47p. (In German). INIS.

The two-nucleon transfer reaction $^{13}C(^3He,n)^{15}O$ has been investigated at two ^3He energies (E = 5.5 MeV and 7.0 MeV). The angular dependence of the polarization and of the differential cross-section of the neutrons from the reaction and the elastically scattered ^3He particles on ^{13}C was measured. The excitation functions of the differential cross-section for reaction angles Θ_{lab} = 0° and 150° were determined. The influence of compound nuclear reactions was estimated. The measured results were discussed by means of DWBA calculations within the framework of direct reactions. (GE)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 24179, 24192, 24202, 24245, 24251, 24289, and 24295.

24228 (JINR-P6-7401) REACTIONS $^{22}Ne(^3He,p)^{24}Na$, $^{22}Ne(^3He,\alpha)^{21}Ne$. Osetinskii, G. M.; Son Von Nam; Faruk, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 17p. (In Russian). INIS.

Studies were carried out on the reactions $^{22}He(^3He,p)^{24}Na$ and $^{22}Ne(^3He,\alpha)^{21}Ne$ in the energy interval of 2.9 to 4.1 MeV. At angles of 45, 90 and 135° measurements were carried out on the excitation function for the states P_0, $P_{1,2}$, P_3, $P_{4,5}$; a_0, a_1, a_2 of the final nuclei ^{24}Na and ^{21}Ne respectively. Measurements were carried out on the angular distributions for the groups $P_{1,2}$, P_3, $P_{4,5}$; a_0, a_1, a_2 of these reactions. A determination was made of the average value of the total level width of the compound nucleus ^{25}Mg in the energy excitation region of 22.65 to 23.7 MeV. (12 refs.) (tr-SJR)

24229 STRENGTHS OF ELECTROMAGNETIC TRANSITIONS BETWEEN BOUND STATES FOR A < 45. Endt, P. M.; van der Leun, C. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 235: No. 1, 27-55(9 Dec 1974).

A recent review of the strengths of about 600 γ-ray transitions between bound states in the A = 21−44 region is extended in the present paper by including (i) the A < 21 region, (ii) recent data on the A = 21−44 region, (iii) E0 transitions, (iv) magnetic transitions of which the (experimentally unknown) mixing ratio can be assumed to be negligibly small. The present addition concerns 350 transitions. Interesting new groups are the isovector E2 transitions (9 cases), and the isoscalar M2 transitions (7 cases). For magnetic transitions, the dependence of isospin retardation on multipolarity is stronger than expected theoretically. Recommended upper limits are presented for the 11 groups with reasonably good statistics. Because the strengths in the A < 21 and A = 21−44 regions differ but little, the same upper limits can be used for the two regions. (auth)

24230 (^3He, 2n) EXCITATION FUNCTIONS FOR SOME LIGHT NUCLEI. Moss, C. E.; Zaidins, C. S. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 235: No. 1, 11-18(9 Dec 1974).

Excitation functions have been measured for the reaction $^9Be(^3He,2n)^{10}C$ over the range $E(^3He)$ = 10−41 MeV and for the reaction $^{27}Al(^3He,2n)^{28}P$ over the range $E(^3He)$ = 14−41 MeV by detecting β-delayed γ-rays. An excitation function has also been measured for the reaction $^{24}Mg(^3He,2n)^{25}Si$ over the range $E(^3He)$ = 21−43 MeV by detecting β-delayed protons. (auth)

24231 BETA DECAY OF ^{23}Mg AND ^{27}Si. Mann, F. M.; Kavanagh, R. W. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., A; 235: No. 2, 299-306(16 Dec 1974).

The β-decays of ^{23}Mg and ^{27}Si have been studied by observing the delayed γ-radiation. The following branches (and log ft values) have been found for ^{23}Mg (β^+)^{23}Na: 0 keV, 0.914 ± 0.002 (3.67); 440 keV, 0.086 ± 0.002 (4.40); and 2391 keV $(6.9 \pm 0.9) \times 10^{-5}$ (4.98); and for $^{27}Si(\beta^+)^{27}Al$: 0 keV, 0.9977 ± 0.0002 (3.61); 1014 keV, $(4.9 \pm 2.4) \times 10^{-5}$ (7.3); 2211 keV, $(1.80 \pm 0.13) \times 10^{-3}$ (4.68); 2734 keV, $(1.55 \pm 0.17) \times 10^{-4}$ (5.02); and 2981 keV, $(2.59 \pm 0.24) \times 10^{-4}$ (4.33). The branches to the 2391-keV level from the ^{23}Mg decay and to the 2734-keV level from the ^{27}Si decay have not been previously reported. A comparison is made between the experimental results and the predictions of the many-particle shell model. (auth)

24232 CHARGED PARTICLES FROM THE GIANT DIPOLE RESONANCE OF ^{26}Mg. Wolf, H.; Stock, R.; Berg, U. E. P.; Wienhard, K. (Giessen Univ. (F.R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 234: No. 2, 365-377(2 Dec 1974).

The $^{26}Mg(\gamma,p)$ and $^{26}Mg(\gamma,\alpha)$ 90° differential cross sections and the $^{26}Mg(\gamma,p)$ total cross section were deduced from particle spectra in the excitation energy region from 16.0 to 23.0 MeV. The (γ,p) cross section is compared with neutron data and with results from a $^{26}Mg(\gamma,x\gamma')$ experiment to clarify the role of isospin effects in the formation of the giant dipole resonance of ^{26}Mg. (auth)

24233 THERMAL NEUTRON CAPTURE STUDIES OF SOME LIGHT ODD−ODD NUCLEI. Ishaq, A. F. M. Hamilton, Ont.; McMaster Univ. (1973). 165p.

Thesis.

Thermal neutron capture studies were made of the odd−odd nuclei, ^{20}F, ^{24}Na, ^{28}Al, ^{32}P, ^{36}Cl and ^{40}K. The gamma ray spectra were studied using a Ge(Li) pair spectrometer and revised decay schemes are presented for these nuclei. The Q-values and gamma ray multiplicities were obtained for the reactions studied. The average partial widths for primary M1 and E1 transitions were calculated for the six nuclei and compared with the theoretical estimates. The features of the capture gamma ray spectra are discussed and it is observed that for the six nuclei studied, the total intensity in the spectrum above the energy of 0.3 times the Q-value is nearly the same (~1.4 photons/capture). (auth)

24234 MEASUREMENT OF ELASTIC SCATTERING OF ^{28}Si FROM ^{28}Si WITH A TIME-OF-FLIGHT-SPECTROMETER FOR HEAVY IONS. Hildenbrand, K. D. (Heidelberg Univ. (F. R. Germany). Naturwissenschaftliche Gesamtfakultaet). 5 Jul 1972. 51p. (In German). INIS.

Available from the library of the Heidelberg Univ.

The angular distribution of ^{28}Si elastically scattered from ^{28}Si was measured for beam energies of 65 MeV and 70 MeV. The separation of elastically scattered particles and recoil nuclei was performed using the different flight times for nuclei with mass 28 and 29. The measurement showed that the time-of-flight spectrometer at the Heidelberg MP-Tandem with its newly-developed time-zero detector was very well suited for such measurements. With its resolution of ΔA/A = 1% in the above-mentioned mass and energy range, it is superior to all other systems used so far. (GE)

24235 THE INFLUENCE OF CORRELATIONS ON THE ODD-MASS NUCLEI ^{21}Ne AND ^{25}Mg. Krewald, S.; Schmid, K. W.; Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 269: No. 2, 125-131(1974).

Excitation energies and electromagnetic properties of the low-energy spectra of ^{21}Ne and ^{25}Mg have been calculated using the multi-configuration Hartree−Fock (MCHF) model. Both T = 0 and T = 1 pairing correlations are found to be simultaneously important in those odd-mass nuclei. Furthermore, though axial symmetry was requested, quite good agreement with the experimental data is reached. (auth)

24236 MEDIUM ENERGY PROTON REACTIONS ON LIGHT CLOSED SHELL NUCLEI. Moffa, P. J. Bloomington, IN; Indiana Univ. (1974). 104p. University Microfilms Order No. 75-1727.

Thesis (Ph. D.).

Theoretical predictions for cross sections, polarizations, and asymmetries were made for medium-energy proton reactions on the light closed-shell nuclei, ^{16}O, ^{28}Si, ^{32}S, and ^{40}Ca. The excitation of high-angular-momentum, nonnormal-parity, T = 1 particle−hole states was stressed. A direct reaction mechanism was assumed, and distorted-wave Born-approximation (DWBA) calculations were performed. Cross section and polarization predictions were presented for both (p,p') and (p,n) reactions. Core polarization and exchange effects were considered. 183-MeV protons were found to be excellent probes of the nuclear interior. It was demonstrated that the results obtained were not very sensitive to the optical potential parameters used as long as a spin−orbit term was included. Presence of a two particle spin−orbit term could not be observed. (RWR)

24237 BRANCHING RATIOS AND LIFETIMES OF ^{25}Mg LEVELS BELOW 5.2 MeV. Ollerhead, R. W.; Kean, D. C.; Gorman, R. M.; Thomson, M. B. (Univ. of Guelph, Ont.). Can. J. Phys.; 52: No. 23, 2329-2342(1 Dec 1974).

All levels below 5.2 MeV in ^{25}Mg have been studied using the reaction $^{25}Mg(p,p'\gamma)$. Inelastically scattered protons were detected in an annular surface barrier detector located at 180°; coincidence gamma-ray spectra were obtained at Ge(Li) detector angles of 90°, 45°, and 135°. Level energies were determined from unshifted gamma-ray energies recorded in the 90° spectra. Lifetimes were obtained from the attenuated Doppler shift of gamma-ray energies recorded in spectra taken at forward and backward angles. Branching ratios were deduced from the combined data of all three angles. The identification of levels as

members of rotational bands is discussed, and transition strengths deduced from the present measurements are compared with predictions of the simple rotational model. (auth)

24238 PRODUCTION OF Ca, Ga, AND Br NUCLEI HAVING ANGULAR MOMENTA EQUAL TO OR GREATER THAN THE CALCULATED LIQUID DROP LIMIT. Namboodiri, M.N.; Chulick, E.T.; Natowitz, J.B.; Kenefick, R.A. (Cyclotron Institute and the Department of Physics and Chemistry, Texas A & M University, College Station, Texas 77843). Phys. Rev. C 11: No. 2, 401-409 (Feb 1975).

A semiconductor detector telescope has been used to detect heavy recoil nuclei produced in the reactions of 157- and 262-MeV ^{14}N projectiles with ^{27}Al, Cr, and Ni target nuclei. Cross sections have been determined for the production of heavy recoiling compound nucleus residues. The limiting angular momenta which have been derived from these cross sections indicate the production of nonfissioning compound nuclei with angular momenta which equal or exceed the critical limit calculated using the liquid drop model. A comparison of the data with limits calculated using a reaction potential model recently proposed by Bass suggests that a picture based on dynamic restrictions to the fusion process provides a reasonable explanation of the results. However, the saturation limit predicted by the Bass model has not been observed. (auth)

24239 THE GAMMA-DECAY OF ^{34}Ar. Grawe, H.; Loehle, U.; Koenig, R. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys.; 268: No. 4, 419-426(Jul 1974).

States in ^{34}Ar up to 5.5 MeV excitation energy, populated by the $^{32}S(^3He,n\gamma)$ reaction at 8–12 MeV bombarding energy, have been investigated with the Doppler shift attenuation method, $n\gamma$ angular correlation and $n\gamma\gamma$ triple coincidence measurements. For the states at 2.09, 3.29 and 4.52 MeV the lifetimes 200 ± 60 fs, 130 ± 60 fs and 260 ± 80 fs have been found. The $n\gamma$ correlations yielded the spin assignments $J^\pi = (2^+)$ for the level at 4.13 MeV and $J^\pi = 3^-$ for the 4.52 MeV state, and the mixing ratios $\delta(3.29 \rightarrow 2.09) = -0.12 \pm 0.05$ and $\delta(4.13 \rightarrow 3.29) = -0.52 \pm 0.15$. The results are compared with shell model calculations and predictions from the weak-coupling unified model. (auth)

24240 HIGH-SPIN STATES IN ^{27}Al. Roepke, H.; Betz, P.; Bender, G.; Glattes, V.; Hammel, G.; Brendler, W. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Z. Phys.; 268: No. 4, 391-399(Jul 1974).

The $^{24}Mg(\alpha,p\gamma)$ reaction has been studied at α-particle energies of 13, 15, and 15.2 MeV. By use of method II of Litherland and Ferguson, spin assignments or restrictions thereof could be made to the ^{27}Al levels at $E_x = 5,500$ ($I = 11/2, 7/2$), 6,950 keV ($I = 11/2, 7/2$), 7,226 keV ($I = 9/2$), 7,286 keV ($I = 9/2 - 13/2$), 7,399 keV ($I = 11/2, 7/2$) and 7,443 keV ($I = 15/2, 9/2$). By use of the Doppler-shift attenuation method a lifetime $\tau = 20-50$ fs was obtained for the $E_x = 7,399$ keV level, and a limit $\tau < 20$ fs for the levels at $E_x = 7,443$, 7,286, 7,226, 6,950, 6,718, and 6,287 keV. Further spin assignments in ^{27}Al were obtained by a study of the $^{26}Mg(p,\gamma)$ reaction at the $E_p = 2,174$ keV resonance. From γ-ray angular distributions the resonance spin was determined as $I = 9/2$ (previous assignment $I = 7/2$), and the spin of the $E_x = 5,959$ keV level was determined as $I = 7/2$. Tentative spin assignments were made to the levels at $E_x = 6,537$ keV ($I = 7/2$) and 6,718 keV ($I = 9/2$). From the combined evidence of the $^{24}Mg(\alpha,p)$ and $^{26}Mg(p,\gamma)$ reactions the spin of the 6,287-keV level was found to be $I = 7/2$. The results are compared with shell model calculations and the Nilsson model. (auth)

24241 STUDY OF THE $^{24}Mg(d,^6Li)^{20}Ne$ REACTION AT 80 MeV. Djaloeis, A.; Ingham, D.; Kelleter, H.; Aspelund, O. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik); Mayer-Boericke, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Bonn Univ. (F. R. Germany). Inst. fuer Strahlen- und Kernphysik). Z. Phys.; 269: No. 2, 133-137(1974).

The $^{24}Mg(d,^6Li)^{20}Ne$ reaction induced by 80-MeV deuterons has been studied using $\Delta E-E$ counter telescopes. The angular distributions leading to several low-lying levels in ^{20}Ne have been measured in the angular range between 15.5° and 102.5° (lab.). The experimental results are compared with the prediction of the DWBA theory assuming a simple pick-up of an alpha-like cluster. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 24179, 24192, 24229, 24233, 24236, 24238, 24259, 24268, 24289, 24291, and 24295.

24242 (HU-P-74/74) ENERGY LEVELS OF ^{54}Mn. Weckstroem, T.; Fant, B.; Forsblom, L.; Viitasalo, M. (Helsinki Univ. (Finland). Dept. of Physics). 1974. 22p. INIS.

Two hundred sixty nine resonances of the $^{53}Cr(p,\gamma)^{54}Mn$ reaction in the proton range $E_p = 1180$ to 2100 keV were observed. The gamma decay of 39 resonances was investigated by means of an 80 cm^3 Ge(Li) detector, and the energies and branching ratios of 55 bound states were determined. The Q value of the reaction was found to be 7559.6 ± 1.0 keV. (auth)

24243 COULOMB–NUCLEAR INTERFERENCE FOR INELASTIC DEUTERON SCATTERING. Baker, F. T.; Kruse, T. H.; Williams, M. E. (Rutgers–the State Univ., New Brunswick, N. J. (USA). Dept. of Physics); Savin, W. (Newark Coll. of Engineering, N. J. (USA)). Nucl. Phys., A; 235: No. 2, 428-435(16 Dec 1974).

The interference between Coulomb excitation and nuclear excitation has been observed for $^{54,56}Fe$, ^{60}Ni, ^{114}Cd, ^{152}Sm, and ^{192}Os by measuring excitation functions of elastic and inelastic deuteron scattering at back angles. The interference is strongly constructive, indicating a predominantly imaginary nuclear form factor. DWBA calculations using the collective model, although predicting constructive interference, are unable to predict the magnitude of the observed effect. (auth)

24244 EXCITATION FUNCTIONS AND ISOBARIC ANALOGUE STATES IN THE $^{55}Mn(p,\gamma)^{56}Fe$ REACTION. Peel, R. J.; Dixon, D. R.; Hill, M. W.; Jensen, G. L.; Mangelson, N. F.; Nath, N.; Rogers, V. C. (Brigham Young Univ., Provo, Utah (USA)). Nucl. Phys., A; 235: No. 1, 205-210(9 Dec 1974).

Four excitation functions with proton energy range 1.3 to 1.85 MeV and γ-ray energy thresholds from 1.5 to 8.0 MeV were determined for the reaction $^{55}Mn(p,\gamma)^{56}Fe$. Gamma-ray spectra were taken for two close-lying resonances at proton energies 1531 and 1537 keV. An analysis of the spectra suggests the spin–parity assignments for those two states to be 4^+ and 2^+, respectively, consistent with their being isobaric analogs to the close-lying third and fourth excited states in ^{56}Mn. (auth)

24245 NONFISSION REACTION RATE MEASUREMENTS. Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID); Helmer, R. G.; Rogers, J. W.; Dudey, N. D.; Popek, R. J.; Kellogg, L. S.; Zimmer, W. H. Nucl. Technol.; 25: No. 2, 274-288(Feb 1975).

Foils of various nonfissile materials commonly utilized in neutron dosimetry were irradiated in the Coupled Fast Reactivity Measurement Facility and quantitatively gamma counted by five groups at four laboratories. Each laboratory used an independently calibrated Ge(Li) detector, and in some cases an NaI(Tl) detector also. These measurements were undertaken as a part of the Interlaboratory LMFBR Reaction Rate (ILRR) program. A primary goal of this initial set of measurements made under the ILRR program was to intercompare the reaction rates determined by the participating groups. The reaction rate values determined by the five groups were all in excellent agreement, generally consistent to within ±2% with respect to each other. With this consistency and the quoted measurement errors as a basis, it is estimated that for most nonfissile dosimetry foils, where the nuclear data are adequate, reaction rates can be determined with an accuracy of ~±2% (standard deviation uncertainty) by using these techniques. This accuracy then easily surpasses the accuracy goal of ±5% (1σ uncertainty) of the ILRR program for nonfissile dosimetry foils. These reaction rates are of sufficient accuracy to be used to test and evaluate energy-dependent cross-section sets currently being evaluated in ENDF/B. (auth)

24246 ISOLATION OF THE GIANT QUADRUPOLE RESONANCE IN ^{58}Ni VIA DEUTERON INELASTIC SCATTERING. Chang, C.C. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Bertrand, F.E.; Kocher, D.C. Phys. Rev. Lett. 34: No. 4, 221-224 (27 Jan 1975).

An investigation of the reaction $^{58}Ni(d,d')$ at E_d=46 and 70 MeV has demonstrated significant advantages in studying isoscalar giant resonances with deuterons compared with other projectiles. The differential cross section at 70 MeV for the resonance at $E_x \simeq 63A^{-1/3}$ MeV provides strong evidence for an E2 interpretation. A comparison of measurements in $^{58}Ni(d,d')$ and (p,p') provides evidence for excitation of the giant dipole resonance by protons. (auth)

24247 NEUTRON RESONANCE SPECTROSCOPY: ARGON. Liou, H.I.; Rainwater, J.; Hacken, G.; Singh, U.N. (Columbia University, New York, New York 10027). Phys. Rev. C 11: No. 2, 457-461 (Feb 1975).

Results are presented of the high-resolution measurements of the neutron total cross section of natural argon to 580 keV. Of the 24 levels observed in ^{40}Ar, 6 are assigned to be $l = 0$, and 18, to be $l = 1$. Resonance parameters were obtained using area and R-matrix analyses for s levels, and area analysis including the Doppler broadening effect for p levels. The s and p strength functions and average level spacing for ^{40}Ar were $10^4 S_0 = 0.91_{-0.37}{}^{+0.77}$, $10^4 S_1 = 0.33_{-0.09}{}^{+0.14}$, $\langle D_0 \rangle = (87^{+\infty}_{-\frac{1}{2}})$ keV, and $\langle D_1 \rangle = (24^{+\infty}_{-\frac{1}{2}})$ keV. (auth)

24248 ^{40,48}Ca(d,p) REACTIONS NEAR THE COULOMB BARRIER: COMPARISON OF COUPLED-CHANNEL AND DISTORTED-WAVE BORN-APPROXIMATION CALCULATIONS. Mukherjee, S.; Shyam, R. (Physics Department, Banaras Hindu University, Varanasi, India). Phys. Rev., C; 11: No. 2, 476-485(Feb 1975).

The (d,p) reactions on ^{40}Ca and ^{48}Ca targets for incident deuteron energies near the Coulomb barrier (2–5.5 MeV) are studied by a coupled-channel (CC) method in which the $\Delta l = 1$ stripping channel has been coupled to the incident deuteron channel. The method employs a set of energy-independent optical potential parameters and predicts differential cross sections and polarizations in both the incident deuteron channel and the stripping channel. The results are compared with the measured values and those obtained from the distorted-wave Born-approximation calculations. It is found that the effect of the coupling is reasonably large even in this low energy region. There is an indication that the CC predictions for ^{40}Ca targets will improve with the inclusion of the coupling of the $\Delta l = 3$ stripping channel. It is also suggested that some portion of the j dependence in (d,p) angular distributions may be simulated by the coupling of the stripping channel. (auth)

24249 CROSS SECTIONS ABOVE 0.3 GeV FOR (p, $2p$) REACTIONS OF ^{48}Ti AND ^{74}Ge. Jacob, N.P. Jr.; Markowitz, S.S. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. C 11: No. 2, 541-545 (Feb 1975).

Cross sections for the ^{48}Ti(p, $2p$)^{47}Sc and the ^{74}Ge(p p)^{73}Ga reactions were measured from 0.3 to 4.6 GeV incident proton energy. A rise in cross section of (25 ± 3) % is observed for each reaction in the energy region from 0.3 to 1.0 GeV. The (p, $2p$) cross sections for ^{48}Ti were found to be systematically about 30% larger than those for ^{74}Ge. Comparisons with four prior cases are made. The present results are compared to (p, $2p$) cross section calculations up to 1.0 GeV based on a Monte Carlo intranuclear cascade–evaporation model. The model yields cross sections that are generally a factor of 2 greater than the experimental values. (auth)

24250 ENERGY LEVELS OF ^{53}Mn FROM THE β-DECAY OF ^{53}Fe. Canto, L. F.; de Barros, S. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Z. Naturforsch., a; 29: No. 5, 702-705(May 1974).

The γ rays following the β-decay of ^{53}Fe were investigated with high-resolution detectors. Two unreported weak transitions were detected at the energies 1,177 ± 1 keV and 2,305 ± 1 keV. Log-ft values were determined and spin and parity assignments made. On the basis of the results attained, a new decay scheme was proposed. Comparison with theoretical calculations is made. (auth)

24251 WIDTHS OF THE 7.74 MeV ANALOGUE STATE IN ^{39}K. Keinonen, J. (Helsinki Univ. (Finland). Dept. of Physics). Z. Phys.; 268: No. 3, 313-316(Jun 1974).

The ^{38}Ar(p,p)^{38}Ar and ^{38}Ar(p,γ)^{39}K reactions have been investigated in the analogue resonance region at $E_p = 1.39$ MeV. For the 7.74-MeV state of ^{39}K branching ratios; unique spin and parity, $J^\pi = \frac{3}{2}^-$; proton and total widths, $\Gamma_p = \Gamma = 1.1 \pm 0.2$ keV, have been determined. (auth)

24252 NMR DETECTED BY MOESSBAUER-EFFECT, APPLIED TO THE SYSTEM ^{57}CoFe. Laurenz, R.; Klein, E.; Brewer, W. D. (Freie Univ. Berlin (F. R. Germany). Inst. fuer Atomund Festkoerperphysik). Z. Phys.; 270: No. 3, 233-237 (Oct 1974).

The detection of NMR in oriented nuclei via the Moessbauer effect in the daughter state is described, and its specific advantages and drawbacks are compared to other methods. As an example, the NMR of ^{57}Co in Fe was observed in external fields of 0–8 kG. The zero field frequency yields a magnetic moment $\mu_{57}/\mu_n = 4.708 \pm 0.012$. The different value found from the slope of the resonance frequency vs. external field is attributed to a Knight shift of (+2.9 ± 1.2)%. (auth)

24253 ^{52}Fe(6.8 MeV) β–DECAYING ISOMERIC STATE. Geesaman, D.F.; Malmin, R.; McGrath, R.L.; Noé, J.W. (Department of Physics, State University of New York, Stony Brook, New York 11974); Cerny, J. Phys. Rev. Lett. 34: No. 6, 326-328 (10 Feb 1975).

An isomeric state in ^{52}Fe has been located at $E_x = 6.83 \pm 0.25$ MeV with the reaction ^{40}Ca(^{14}N, pn)^{52}Fe. The state decays by positron emission to the (11$^+$)3.837–MeV state of ^{52}Mn with $T_{1/2} = 56 \pm 8$sec. The probable spin and parity of the isomer is 12$^+$. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 24238, 24243, 24245, 24249, 24256, 24272, 24274, 24289, 24291, 24295, 24307, and 24312.

24254 (JINR-6-7476) TWO-PARTICLE STATE OF ^{88}Zr WHILE EXCITING AT THE ^{88}Nb DECAY. Bayar, B.; Votsilka, I.; Gosior, M.; Zaitseva, N. G.; Kratsik, B.; Kuznetsov, V. V.; Liptak, Ya.; Lazurei, G. I.; Novgorodov, A. F.; Ortlepp, Kh. G.; Toshev, M.; Khabenikht, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 12p. (In Russian). INIS.

The γ, γ-γ coincidence, and internal conversion electron spectra during the decay of ^{88}Nb was studied. 33 γ transitions were detected. The multipolarities of the γ transitions at 76.7 and 271.4 keV were determined. The level scheme of ^{88}Zr was extensively supplemented and the level structure was discussed. (tr-auth)

24255 (JINR-P1-8313) INELASTIC INTERACTIONS OF 17 GeV/c α-PARTICLES WITH NUCLEI. Tolstov, K. D.; Totova, M.; Tuckek, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The use of photoemulsions of two types, the first having ordinary composition of nuclei (BR-2) and the second enriched with light nuclei (H, C, O), makes it possible to determine the cross sections of the interactions of 17-GeV/c α particles with C, O and Ag, Br nuclei: $\sigma_C = (380 \pm 38)$ mb, $\sigma_O = (460 \pm 47)$ mb, $\sigma_{Br} = (1520 \pm 65)$ mb, $\sigma_{Ag} = (1850 \pm 80)$ mb. The mean multiplicities of shower and heavy particles for the interaction of α particles with emulsion nuclei are $\langle n_s \rangle = 4.44 \pm 0.07$, $\langle n_h \rangle = 9.08 \pm 0.24$. The cross sections and mean multiplicities on the mean effective emulsion nucleus were measured for the following events: α-particle fragmentation and stripping (in case of emission of one- charged relativistic particle with $\theta < 3°$— α A–1); case of emission of two-charged relativistic particles with $\theta < 3°$— α A–2. $\sigma_{\alpha A-1} = (340 \pm 40)$ mb, $\langle n_s \rangle_{\alpha A-1} = 3.70 \pm 0.10$, $\langle n_h \rangle_{\alpha A-1} = 5.20 \pm 0.20$; $\sigma_{\alpha A-2} = (100 \pm 15)$ mb, $\langle n_s \rangle_{\alpha A-2} = 1.24 \pm 0.10$, $\langle n_h \rangle_{\alpha A-2} = 4.35 \pm 0.28$. Angular and momentum distributions are given for events of the type α A-1 and α A-2. (9 figures, 2 tables) (auth)

24256 (KFK-2056) TOTAL NEUTRON CROSS SECTIONS OF ^{63}Cu AND ^{65}Cu IN THE ENERGY REGION 34 TO 150 keV. Beer, H.; Spencer, R. R.; Rohr, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). Oct 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

Neutron total cross sections of ^{63}Cu and ^{65}Cu were determined in the energy region from 34 to 150 keV by means of transmission measurements on enriched samples. R-matrix fits to the transmission data were carried out, and the parameters which were derived are presented. (auth)

24257 TECHNIQUES USED IN REACTION-RATE MEASUREMENTS IN THE CONVERTER FACILITY NISUS. Azad, S. (Imperial Coll. of Science and Technology, London (UK). Nuclear Power Group). Nucl. Instrum. Methods; 121: No. 3, 591-597(1 Nov 1974).

Absolute reaction rates of a group of materials are measured in the spectrum of a converter facility. The measurement is performed by gamma counting the radioactive product nuclides on a Ge(Li) detection system. In addition to experimental techniques and the basic nuclear data used, a comparison between experimental and theoretical spectral indices is given. (auth)

24258 COULOMB EXCITATION OF THE EVEN-MASS SELENIUM NUCLEI. Barrette, J.; Barrette, M.; Lamoureux, G.; Monaro, S. (Montreal Univ., Quebec (Canada). Lab. de Physique Nucleaire); Markiza, S. (Loyola Coll., Montreal, Quebec (Canada). Dept. of Physics). Nucl. Phys., A; 235: No. 1, 154-170(9 Dec 1974).

The properties of the low-lying states of the doubly even selenium nuclei have been investigated via multiple Coulomb excitation effected with 39.2-MeV oxygen projectiles. The excitation probabilities of the first 2$^+$ states of ^{76}Se, ^{78}Se and ^{80}Se have been determined directly by resolving inelastically and elastically scattered ^{4}He projectiles on thin targets. These measurements yielded values of $B(E2; 0^+ \rightarrow 2^+)$ equal to 0.421 ± 0.009 (^{76}Se), 0.321 ± 0.009 (^{78}Se), and 0.248 ± 0.005 (^{80}Se) $e^2 \cdot b^2$. The multiple Coulomb excitation experiments enable the detection of 2$^+$ and 4$^+$ levels in all isotopes studied up to 2.1 MeV. Moreover, the double Coulomb excitation of 0$^{+\prime}$ states at 854.1 keV (^{74}Se), 1498.5 keV (^{78}Se), and 1478.3 keV (^{80}Sc) was also observed. The enhancement of the E2 transition between these 0$^{+\prime}$ levels and the first 2$^+$ states decreases rapidly with the increase of the neutron number, i.e., $B(E2; 0^{+\prime} \rightarrow 2^+)/B(E2; 2^+ \rightarrow 0^+) = 2.04 \pm 0.08$ (^{74}Sc), 0.91 ± 0.08 (^{76}Sc), and 0.28 ± 0.04 (^{80}Sc). States interpreted as the result of direct E3 Coulomb excitation have been observed at 2350.2, 2429.2, 2507.6, and 2717.6 keV in ^{74}Se, ^{76}Se, ^{78}Se, and ^{80}Se, respectively. Their $B(E3; 0^+ \rightarrow 3^-)$ values are 2.1 ± 0.5 (^{74}Se), 4.0 ± 0.5 (^{76}Se), 2.7 ± 0.3 (^{78}Se), and 0.9 ± 0.2 (^{80}Se) × 10^{-2} $e^2 \cdot b^3$, which represent enhancements of 9.2 ± 2.2, 16.6 ± 2.1, 10.8 ± 1.2, and 3.2 ± 0.7, respectively. Furthermore, angular distribution mea-

surements of γ-rays following Coulomb excitation with 42-MeV ^{16}O ions in ^{78}Se and ^{80}Se have been performed. The E2 content of the $2^{+}_{1} \rightarrow 2^{+}$ transition in these two nuclei is 87.9% (^{78}Se), and 96.2% or 33.5% (^{80}Sc). (auth)

24259. INVESTIGATION OF NEUTRON DEFICIENT NUCLEI IN THE REGION 28 = N, Z = 50 WITH THE HELP OF HEAVY ION COMPOUND REACTIONS. Nolte, E.; Shida, Y.; Kutschera, W.; Prestele, R.; Morinaga, H. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Phys.; 268: No. 3, 267-288(Jun 1974).

In-beam γ-ray spectroscopy with γ singles spectra, γγ coincidences and γ-ray angular distributions has been performed with several target–projectile combinations: $^{nat}Ca + ^{32}S$, $^{nat}Ca + ^{48}Ca$, $^{54}Fe + ^{16}N$, $^{58}Ni + ^{12}C$, $^{58}Ni + ^{16}N$, $^{66}Zn + ^{16}O$, $^{68}Zn + ^{16}O$. Level schemes and spin–parity assignments of ^{66}Ge, ^{68}Ge, ^{69}As, ^{70}Se, ^{74}Kr, ^{80}Sr and ^{82}Sr have been deduced. γ-ray activity spectra have been measured after the bombardment of natural Ca with ^{32}S. The half-life of the new isotope ^{69}Se has been found to be 27 ± 3 sec. Recoil distance Doppler-shift measurements have been performed with the reactions $^{62,64}Ni$, $^{66}Zn(^{16}O,2n)^{76,78}Kr$, ^{86}Sr. The following half-lives have been determined: ^{76}Kr: 423.8 keV, 2^{+}, 37 ± 5 psec; 1.034.2, 4^{+}, 5.7 ± 1.6; ^{78}Kr: 455.3, 2^{+}, 25 ± 3; 1,120.0, 4^{+}, 3.8 ± 1; ^{80}Sr: 385.4, 2^{+}, 44 ± 6. The energy and half-life systematics of the first excited state of even–even nuclei suggest a maximum of nuclear deformation in the region 28 ≤ N, Z ≤ 50 near $^{72}_{38}Sr_{34}$ or $^{72}_{40}Zr_{32}$. (GE)

24260 NUCLEAR STRUCTURE OF ^{70}Ga. Dohan, D. A. Hamilton, Ont.; McMaster Univ. (1973). 134p.

Thesis.

The nuclear properties of ^{70}Ga were investigated by high resolution studies of the reactions $^{69}Ga(d,p)^{70}Ga$ and $^{71}Ga(d,t)^{70}Ga$. Seven levels exist below 1 MeV excitation, with a large gap of 508 keV separating the first two. Between 1 and 2 MeV, 42 additional levels are observed. Parities and spectroscopic factors for the low lying levels were extracted by DWBA analysis of the proton and triton angular distributions. Electromagnetic decay properties of the levels of ^{70}Ga were investigated by means of the $^{70}Zn(p,n\gamma)^{70}Ga$ reaction. Gamma ray angular distribution and linear polarization measurements were used to elucidate spins of low lying levels and mixing ratios of the transitions. Gamma-ray yields as a function of energy are shown to depend markedly on the spin of the level, in agreement with Hauser–Feshbach calculations for the (p,n) cross section. Analysis of the decay of the low lying levels indicates the existence of remarkably few E1 transitions. A theoretical calculation of the energy levels of ^{70}Ga is presented in the light of the shell model. Both the zero range and surface delta interactions were used as the residual interaction between the nucleons. The surface delta interaction is shown to reproduce the energy levels much better than the zero range force, but fails to predict the large energy gap between the first two levels. (auth)

24261 TRANSFER OF ENERGY TO PHOTO-EMULSION ATOM NUCLEUS. Just, L. (Inst. of Experimental Physics, Kosice, Czech.); Andrejkova, G. Acta Phys. Slovaca; 23: No. 3, 181-186(1973).

Certain aspects of collisions between fast particles and atomic nuclei were studied, especially the transfer of energy to the nucleus and its return to the unexcited state. (1 figure, 1 table) (Nucl. Sci. Abstr. Czech.)

24262 STUDY OF THE REACTIONS $^{62}Ni(^{7}Li,^{6}He)^{63}Cu$ AND $^{12}C(^{6}Li,\alpha)^{14}N$. White, R. L. Tallahassee; Florida State Univ. (1974). 136p. University Microfilms Order No. 75-981.

Thesis (Ph. D.).

Angular distributions from the $^{62}Ni(^{7}Li, ^{6}He)^{63}Cu$ reaction were studied at a bombarding energy of 34.0 MeV from 1° to 40° (lab). These angular distributions exhibit final-state L dependence for angles larger than 5°. In addition, between 1° and 5° there is a marked final-state J dependence seen in the L = 1 levels. The reactions $^{62}Ni(^{7}Li,^{7}Li)^{62}Ni$ at $E(^{7}Li)$ = 34.0 MeV and $^{63}Cu(^{6}Li,^{6}Li)^{63}Cu$ at $E(^{6}Li)$ = 28.1, 30.1, and 32.1 MeV were performed, and data were taken for angles from 10° to 75°. No discrete ambiguities in the optical parameters were observed. Also, no energy dependence in the optical-model parameters could be extracted for the ^{63}Cu (^{6}Li,^{6}Li)^{63}Cu reaction. Finite-range DWBA calculations reproduce the shapes of the data well. Spectroscopic factors were extracted. The (^{7}Li, ^{6}He) reaction should be a very useful spectroscopic tool. Excitation functions of the reaction $^{12}C(^{6}Li,\alpha)^{14}N$ were taken in the energy range 32.2 to 35.2 MeV in steps of 100 keV. The measurements were made for the first nine T = 0 states in ^{14}N at laboratory angles of 15° and 65°. These excitation functions show no structure and are suggestive of a direct reaction. Sixty-four point angular distributions in the angular range 15° to 165° were taken at $E(^{6}Li)$ = 33.0 MeV. The compound-nucleus contribution was found to be negligible. The angular distributions were analyzed with three types of DWBA calculations; none of the three calculations could satisfactorily reproduce the data. It was also shown that the two-step reaction proceeding through the E_x = 4.43 MeV, $J^{\pi} = 2^{+}$ state of ^{12}C could be an important component of the cross sections in this reaction. (RWR)

24263 ODD–EVEN DIFFERENCES IN THE ELASTIC SCATTERING OF α PARTICLES BY A = 62–66 NUCLEI. Bosman, M.; Leleux, P.; Macq, P.C.; Meulders, J.P.; Pirart, C. (Institut de Physique Corpusculaire, Université de Louvain, B–1348 Louvain–la–Neuve, Belgium). Phys. Rev. C 11: No. 2, 628-630 (Feb 1975).

Odd–even differences in the elastic scattering of 48-MeV α particles by $^{62,64}Ni$, $^{63,65}Cu$, and $^{64,66}Zn$ are well accounted for, up to back angles, by core polarization. (auth)

24264 WHERE IS THE $g_{9/2}$ PROTON STATE IN ^{87}Rb? Medsker, L. R.; Fortune, H. T.; Headley, S. C.; Bishop, J. N. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania (19174). Phys. Rev., C; 11: No. 2, 474–475(Feb 1975).

A strong l_p = 4 transition [with $(2J + 1)C^2S = 10.3 \pm 1.5$] observed in the $^{86}Kr(^{3}He,d)^{87}Rb$ reaction establishes the 1579-keV state as the $g_{9/2}$ proton single-particle state and resolves a longstanding discrepancy. (auth)

24265 NEAR–THRESHOLD RESONANCE NEUTRONS FROM $^{63}Cu(p, n_0)^{63}Zn$ AND $^{68}Zn(p, n_0)^{68}Ga$. Lefevre, H.W.; Kneff, D.W. (Department of Physics, University of Oregon, Eugene, Oregon 97403). Phys. Rev. C 11: No. 2, 524-528 (Feb 1975).

We report the observation and study of several narrow resonances near threshold in the reactions $^{63}Cu(p, n_0)^{63}Zn$ and $^{68}Zn(p, n_0)^{68}Ga$. The first resonance above threshold in $^{63}Cu(p, n_0)^{63}Zn$ occurs at a proton energy 299 eV above threshold and has a c.m. width of 25 ± 10 eV. That for $^{68}Zn(p, n_0)^{68}Ga$ occurs at a proton energy 622 eV above threshold and has a c.m. width of 8 ± 1 eV. (auth)

24266 CORRELATIONS IN COMPOUND–NUCLEUS DECAY AMPLITUDES IN THE VICINITY OF ISOBARIC ANALOG STATES. Davis, S.; Glashausser, C.; Robbins, A.B.; Bissinger, G. (Rutgers University, New Brunswick, New Jersey 08903); Albrecht, R.; Wurm, J.P. Phys. Rev. Lett. 34: No. 4, 215-218 (27 Jan 1975).

Polarization and $(p,p\gamma)$ angular–correlation studies near isobaric analog resonances in proton scattering from ^{92}Mo and ^{106}Cd indicate strong correlations between compound–nuclear decay channels. A modified Hauser–Feshbach formula which includes correlations among those channels which belong to the analog resonance can explain the data. (auth)

24267 THE DECAY OF $^{70}_{33}Se_{37}$. ten Brink, B. O.; Vis, R. D.; Kalshoven, A. W. B.; Verheul, H. (Vrije Universiteit, Amsterdam (Netherlands). Natuurkundig Lab.). Z. Phys.; 270: No. 2, 83–87 (Oct 1974).

The decay of ^{70}Se was studied using a 75-cm^3 Ge(Li) detector, placed in an anti-Compton shield, and a low-energy detector. Of the 36 γ-rays observed, 31 are placed in a level scheme of ^{70}As, based on coincidence and sum relations. Conversion electrons of two low-energy transitions were observed in order to determine their multipolarity. The half-life measured is 41.1 min. Spins and parities of the excited levels were deduced and compared with shell-model predictions, and log-ft values of the EC/β^{+} branches were calculated. (auth)

24268 ABSOLUTE DIFFERENTIAL NEUTRON EMISSION CROSS SECTIONS FOR Mn, Fe, Co, Ni, Cu, Zn AT 14 MeV INCIDENT ENERGY. Hermsdorf, D.; Sassonoff, S.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden). Kernenergie; 17: No. 8, 259-265(Aug 1974). (In German).

The second part of a publication on data for more than 30 elements is presented. The neutron emission spectra of the elements Mn, Fe, Co, Ni, Cu, and Zn were measured at 14 MeV by means of time-of-flight spectrometry and absolute source strength determination. The spectra are given in the energy range from 2 to 14 MeV for five scattering angles. The cross sections are integrated over energy and angle, and given in both graphical and parametrized form. All results are discussed and compared with values from the literature. (13 figures, 4 tables) (tr-auth)

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Refer also to abstracts 22159, 23500, 23871, 24243, 24245, 24255, 24278, 24311, 24324, 24361, 24362, and 24375.

24269 (GKSS-74/E/39) PARAMETERS OF THE 0.178-eV NEUTRON RESONANCE OF ^{113}Cd. Harz, U. (Gesellschaft fuer

Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 49p. (In German). Dep. NTIS (US Sales Only) $5.50.

The total neutron excitation cross section of Cd in the energy range from 0.02 eV to 10 eV was measured with the fast chopper neutron time-of-flight spectrometer. The parameters of the resonance of ^{113}Cd were determined by theoretical analysis with the SHAPE program. (tr-auth)

24270 (GSI-tr-14/74) THE DELAYED PROTON EMITTER ^{119}Ba. Bogdanov, D. D.; Karnaukhov, V. A.; Petrov, L. A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). May 1974. 5p. (In German). INIS.

Translated from JINR P6-7272. Published in: Yadernaya Fizika.

A new delayed proton emitter, ^{119}Ba, was obtained from the reaction ^{106}Cd(^{16}O,3n). The identification was made using the excitation function. The half-life of 5.0 ± 0.6 s and the proton spectrum were measured. By comparing the shape of the spectrum and calculations from the statistical model, the total β-decay energy was found to be Q_β = 7.1 ± 1.0 MeV. (GE)

24271 (JINR-6-7693) STUDY ON THE EXCITED STATES OF NEAR-MAGIC ^{147}Gd NUCLEUS. Budzynski, M.; Ion-Mikhai, R.; Morozov, V. A.; Fuya, Kh.; Behdike, T.; Marupov, N. Z.; Muminov, T. M.; Kholbaev, I.; Subotovich, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 15p. (In Russian). INIS.

The life-times of the following levels were measured: 1152 Kev <0.20 nsec, 1292 Kev <0.20 nsec and 1411.7 Kev <0.35 nsec; and the angular gamma-gamma correlation was measured for the cascades: (694-1152) Kev and (140-1152) Kev. The spin of the 1152 Kev level was established as 5/2. (tr-SJR)

24272 DETERMINATION OF NUCLEAR PARAMETERS BY INELASTIC ELECTRON SCATTERING AT LOW-MOMENTUM TRANSFER. Yen, R.; Cardman, L. S.; Kalinsky, D.; Legg, J. R.; Bockelman, C. K. (Yale Univ., New Haven, Conn. (USA). Electron Accelerator Lab.). Nucl. Phys., A; 235: No. 1, 135-153 (9 Dec 1974).

The second-order Born-approximation treatment of Cutler and Schucan was applied to inelastic electron scattering data on ^{6}Li, ^{60}Ni, and ^{114}Cd acquired at low momentum transfers. The form factors as a function of momentum transfer q in the range of 0.25−0.57 fm^{-1} were obtained by angular distribution measurements performed at incident energies of 30 to 60 MeV. The correlation between two parameters deduced from the measurements, the reduced transition probability B(E2↑) and the transition radius $R_{tr}^{(2)}$, is discussed. It is suggested that inelastic electron scattering data at low q is best used either in conjunction with an accurate value of B(EL↑) (available from the model-independent analysis of "photon" experiments at zero momentum transfer) to allow accurate determination of $R_{tr}^{(2)}$, or in conjunction with high-q inelastic electron scattering data to allow accurate determination of B(EL↑) as well as $R_{tr}^{(2)}$. (auth)

24273 RUTHENIUM-99 MOESSBAUER SPECTRA OF SOME NITRIDO COMPLEXES OF Ru(VI). Gibb, T. C.; Greatrex, R.; Greenwood, N. N.; Meinhold, R. H. (Leeds Univ. (UK)). Chem. Phys. Lett.; 29: No. 3, 379-382(1 Dec 1974).

The quadrupole splittings found in the ^{99}Ru Mössbauer spectra of (Bu_4^nN) [$RuNCl_4$] and (Ph_4As) [$RuNBr_4$] at 4.2 K are the largest yet observed for this isotope. The six component lines are almost resolved, and lead to new estimates for the ratio of the nuclear quadrupole moments of Q_e/Q_g = +2.82 ± 0.09 and for the E2/M1 mixing ratio of δ^2 = 2.64 ± 0.17. By contrast, the spectrum of Cs_2 [$RuNCl_5$] has a much smaller quadrupole splitting and a more negative isomer shift. These differences can be interpreted empirically in terms of the asymmetric occupation of the 4d orbitals. The new data confirm an earlier deduction that both Q_e and Q_g are positive. (auth)

24274 ENERGY SPECTRA OF DELAYED NEUTRONS FROM SEPARATED FISSION PRODUCTS. II. The Precursors ^{89}Br, ^{91}Br, ^{93}Rb, ^{139}I, ^{141}(I + Cs) and ^{143}Cs. Rudstam, G.; Shalev, S. (Forskningsraadens Lab., Studsvik (Sweden)). Nucl. Phys., A; 235: No. 2, 397-409(16 Dec 1974).

This article is one of a series presenting delayed-neutron energy distributions for mass-separated fission products. Experimental energy spectra were obtained for the delayed neutron precursors ^{89,91}Br, ^{93}Rb, ^{139}I, ^{141}I and ^{143}Cs. Average level spacings, neutron envelopes and P_n values were calculated and compared with the experimental data. Reasonable agreement was obtained in most cases, although it was necessary to postulate Q_β values of 6.22 and 5.8 MeV for ^{89}Br and ^{91}Br, and 5.84 MeV for ^{139}I. (auth)

24275 NUCLEAR STRUCTURE STUDIES OF ^{97}Ru FROM THE DECAY OF ^{97g,m}Rh. Ohya, S. (Tokyo Inst. of Tech. (Japan). Dept. of Physics). Nucl. Phys., A; 235: No. 2, 361-377(16 Dec 1974).

The energy levels of ^{97}Ru have been studied through the decay of 31.1-min ^{97g}Rh and 44.3-min ^{97m}Rh by using Ge(Li), Si(Li), NaI, plastic and anthracene detectors in singles and in coincidence experiments. A total of 139 γ-rays were observed. Ninety-eight γ-rays have been placed into the decay schemes involving 38 excited levels in ^{97}Ru. The level energy of ^{97m}Rh was determined to be 258.6 keV. The spin and parity of ^{97g}Rh and ^{97m}Rh are assigned as $9/2^+$ and $1/2^-$, respectively. The fraction of decay of the isomer by the isomeric transition was measured with the Si(Li) detector, and α_K values were determined for strong transitions. The half-life of the 188.6-keV $3/2^+$ state in ^{97}Ru was determined as 0.23 ± 0.02 ns by delayed e−γ coincidence measurements. The nuclear structure of low-lying levels is compared with similar levels in other odd-mass nuclei (N = 53 isotones and Ru isotopes). (auth)

24276 DIRECTIONAL DISTRIBUTION OF γ-RAYS FROM ORIENTED ^{133}I. Koene, B. K. S.; Ligthart, H.; Postma, H. (Rijksuniversiteit Groningen (Netherlands)). Nucl. Phys., A; 235: No. 2, 267-277(16 Dec 1974).

Directional distributions of γ-rays emitted by oriented ^{133}I nuclei were studied with Ge(Li) detectors. Nuclear orientation was achieved at temperatures below 0.04 K by using the magnetic hyperfine interaction of ^{133}I implanted in iron. Spin values have been deduced for nearly all ^{133}Xe levels populated in the ^{133}I decay. Multipole mixing ratios of eighteen γ transitions are reported; in addition, the relative strengths of angular momentum components in some of the γ branches were extracted. (auth)

24277 DIRECTIONAL CORRELATIONS OF γ-TRANSITIONS IN ^{134}Xe. Gualda, J. M.; Saxena, R. N. (Instituto de Energia Atomica, Sao Paulo (Brazil)); Zawislak, F. C. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Instituto de Fisica). Nucl. Phys., A; 234: No. 2, 357-364(2 Dec 1974).

The directional correlations of coincident γ-transitions in ^{134}Xe were measured using a Ge(Li)−NaI(Tl) spectrometer. Spin assignments were made for the levels at 1920 (3^+), 2136 (5^+), 2272 (4^+) 2352 (4^+), 2408 (5^+) 2588 (4^+) and 2867 keV (4^+). In addition previous spin assignments of levels at 1613 (2^+) and 1731 keV (4^+) were also confirmed. The multipole mixing ratios δ(E2/M1) obtained from the present data are: $\delta(405) = 0.80^{+0.7}_{-0.4}$, $\delta(433) = 0.08 \pm 0.06$, $\delta(540) = -1.92 \pm 0.1$, $\delta(595) = -0.32 \pm 0.20$, $\delta(621) = -0.76 \pm 0.05$, $\delta(677) = -0.32 \pm 0.02$, $\delta(766) = -2.4 \pm 0.2$, $\delta(857) = -0.64 \pm 0.1$, $\delta(948) = -0.40 \pm 0.10$, $\delta(1072) = -0.16 \pm 0.02$ and $\delta(1136) = 0.48 \pm 0.02$. (auth)

24278 THE (d,α) REACTION VIEWED AS A TWO-STEP PROCESS. Schoonover, J. L.; Hinrichsen, P. F.; Kitching, J. E.; Lee, J. K. P.; Mark, S. K. (McGill Univ., Montreal, Quebec (Canada). Foster Radiation Lab.). Nucl. Phys., A; 234: No. 2, 331-345(2 Dec 1974).

The ^{96,97,94}Mo(d,α)^{96,95,92}Nb and ^{93}Nb(d,α)^{91}Zr reactions were studied at 12 MeV bombarding energy. A DWBA analysis using one- and two-step processes was carried out. The two-step process is found, in general, to dominate the one-step and together give rise to cross section predictions within a factor of 10 of experiment. The angular distribution patterns are found to be best reproduced by DWBA predictions based on certain L-transfers ("parity violating") associated with only the two-step process and which play but a minor role in their contribution to the overall cross section. (auth)

24279 DECAY OF ^{124}Sb. Johnson, J. R. Vancouver, B. C.; Univ. of British Columbia (1973). 168p.

Thesis.

The gamma-rays, beta rays and conversion electrons emitted in the beta decay of ^{124}Sb → ^{124}Te were observed using Ge(Li) and Si(Li) detectors both singly and in coincidence. The measured energies and intensities of the different transitions involved in this decay together with the coincidence results have allowed one to construct the decay scheme. The angular momentum of most of the states and the parity of all of the states of ^{124}Te populated in this decay were deduced, some of them for the first time, and others as confirmations of previous assignments. One could also assign collective parameters to many of these states, in terms of the vibrational model of nuclei, from the reduced branching ratios calculated from the gamma ray intensities. (auth)

24280 ENERGY LEVELS OF ^{117}In AND ^{171}Lu. Gregory, P. R. Hamilton, Ont.; McMaster Univ. (1973). 152p.

Thesis.

The energy levels of ^{117}In populated in the beta decay of ^{117}Cd and ^{117m}Cd were studied with the aid of Ge(Li) gamma ray detectors singly and in coincidence mode. A decay scheme based on the present results is proposed, and speculation is made concerning a possible interpretation of some of the levels as

a rotational band based on the $\frac{1}{2}$+[431] Nilsson orbital. The energy levels of ^{171}Lu populated by single particle transfer reactions were studied using an Enge spectrograph and a number of Nilsson assignments are made. These results were complemented by a study of the gamma rays and conversion electrons following the reaction ^{169}Tm(α,2n)^{171}Lu, using Ge(Li) detectors and an on line Orange spectrometer. Assignments were made to high spin for rotational bands based on five Nilsson orbitals. In addition some interesting K forbidden interband transitions were observed and discussed in terms of Nilsson model branching ratio predictions. (auth)

24281 SINGLE-NUCLEON TRANSFER REACTIONS IN Br AND Mo ISOTOPES. Cheung, H. C. Montreal; McGill Univ. (1973). 235p.

Thesis.

The ^{94,96,98,100}Mo(^{3}He,d)^{95,97,99,101}Tc and ^{79,81}Br(d,p)^{80,82}Br reactions are investigated with an 18-MeV ^{3}He beam and a 12 MeV deuteron beam, respectively, from tandem accelerators. Measurements are performed using ΔE-E silicon detector telescopes and Enge split-pole magnetic spectrograph. For the detector telescope method, techniques of "range-energy" electronic charged particle identification are employed. A total of 198 low lying states in ^{95,97,99,101}Tc and ^{80,82}Br are identified. Most of these states are observed for the first time. The differential cross section angular distributions of 127 of the observed states are analyzed with the DWBA theory; the l-transfer values, spectroscopic factors and spin–parity assignments for the levels are deduced. The results are interpreted in terms of the shell model using the spectroscopic sum rules. The observed nuclear systematics and the deduced target nucleus configurational structure are discussed. (auth)

24282 ENERGY LEVELS OF ^{132}Xe, ^{133}Xe, ^{135}Xe, AND ^{140}Ce: A GAMMA RAY STUDY. Saxena, R. N. Waterloo, Ont.; Univ. of Waterloo (1973). 223p.

Thesis.

The energies and relative intensities of the γ-rays following the decay of ^{132}I and ^{135}I were measured. Gamma–gamma coincidences were measured. The decay of ^{133}I was found to involve 29 γ-rays and to populate 13 excited states in ^{133}Xe. A comparison of positive parity states found in this study was made with those predicted by the intermediate coupling model. There were 57 γ-rays identified in the β-decay of 6.7 h ^{135}I. A level scheme of ^{135}Xe incorporating 24 excited states was proposed based on the coincidence data and relative intensities of the observed γ-rays. Tentative spin and parity assignments were made. The directional correlations of coincident gamma transitions in ^{132}Xe and ^{140}Ce were measured. The γ–γ coincidences were accumulated at 14 different angular positions. The multipole mixing ratios δ were obtained from the correlation data. The predicted electron-conversion coefficients are compared with the experimentally measured values, and the spins and parities of the levels were assigned. The results are discussed in terms of collective vibrational model. The model is of limited value in explaining the experimental data concerning the level structure and multipole admixture of γ-transitions in ^{132}Xe. The γ–γ directional correlations of 9 cascades in ^{140}Ce were measured. The predicted electron-conversion coefficients were compared with the experimentally observed values. Spin and parity assignment was made for the levels. Positive parity states were compared with those predicted from the shell-model calculations. (MGH)

24283 THE ELECTRON CAPTURE DECAY OF ^{125}I AND ^{145}Pm. Tolea, F.; Baker, K. R.; Schmidt-Ott, W. D.; Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). Z. Phys.; 268: No. 3, 289-292(June 1974).

1 fig.; 2 tabs.; 15 refs.

The product $P_K\omega_K$ of the K-capture probability and the K-fluorescence yield ω_K was measured in the EC decay of 17.7-y ^{145}Pm and 60.14-d ^{125}I by means of K X-ray–γ-ray coincidences with semiconductor detectors. A best value of ω_K = 0.920 for Z = 60 from the literature was accepted, and values of P_K = 0.606 ± 0.025 and 0.554 ± 0.025 for decay of ^{145}Pm to the 67.2- and 72.4-keV levels in ^{145}Nd, respectively, were determined, from which the application of EC theory gives Q_{EC} = 153 ± 4 keV to the ground state. The $P_K\omega_K$ ratio to the 67.2- and 72.4-keV levels also was determined independently to be 1.11 ± 0.01, which serves as a good check on the γ-ray-gated P_K values. The γ-ray energies were determined more accurately to be 72.4 ± 0.1 and 67.2 ± 0.1 keV, together with a ratio of their relative intensities, $I_{72.4}/I_{67.2}$ = 3.35 ± 0.09. In the decay of ^{125}I, a value of $P_K\omega_K$ = 0.699 ± 0.030 was measured; and by using an independent determination of Q_{EC} = 178 ± 2 keV to the ground state from the literature, a value of P_K = 0.801 is calculated from allowed EC theory, from which ω_K = 0.873 ± 0.017 at Z = 52 is obtained. (auth)

24284 NEUTRON CAPTURE CROSS SECTION OF ^{147}Nd. Heck, D.; Boerner, H.; Pinston, J. A.; Roussille, R. (Institut Max von Laue–Paul Langevin, 38–Grenoble (France)). Atomkernenergie; 24: No. 2, 141(1974).

1 fig.; 9 refs.

To determine the burnup of reactor fuel elements it is sufficient to measure the number of atoms of a certain stable fission product. For a long time ^{148}Nd was considered to be a reliable fission product monitor, as its neutron capture cross section is low (≈ 2.5 b) and the preceding A = mass chain members are short lived (<2 min). Recently it has been supposed that the ^{148}Nd fission product measurements are falsified by neutron capture in the 11.1-d ^{147}Nd with the conclusion that the unknown ^{147}Nd cross section might be in the 200 to 300 b region. An attempt is described to derive a value of the ^{147}Nd cross section, which enables more reliable corrections in burnup measurements. (GE)

24285 THE β-MOMENTS FOR THE SECOND-FORBIDDEN β-DECAY FROM ^{137}Cs, THE CVC THEORY, AND THE RESIDUAL INTERACTIONS. Szybisz, L. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Z. Phys.; 269: No. 2, 139-145(1974).

4 figs.; 4 tabs.; 38 refs.

The β-moments of the $\frac{7}{2}$+(1.176-MeV β^-)$\frac{3}{2}$+ transition in the decay of ^{137}Cs have been extracted from the available experimental data. The following values have been obtained: $\langle R_{ij}\rangle/R^2 = 0.035 \pm 0.020$, $\langle iT_{ij}\rangle/R^2 = 0.067 \pm 0.036$, and $-0.085 \leq \langle S_{ijk}\rangle/R^2 \leq 0.085$. These results show that the β-moments are reduced with respect to those evaluated by means of the conventional pairing model. These quenching effects are similar to those previously found in the analyses of first-forbidden β-decays and are attributed to residual charge-exchange interactions. The results for $\Lambda(= -\langle iA_{ij}\rangle/\xi\langle R_{ij}\rangle)$ are discussed in the light of the predictions of the CVC theory. (auth)

24286 THE TOTAL NEUTRON CROSS SECTION OF Cd 113 AT 0.178 eV. Harz, U.; Priesmeyer, H. G. (Kiel Univ. (F.R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Atomkernenergie; 24: No. 2, 142-143(1974).

1 fig.; 2 tabs.; 11 refs.

The neutron transmission of natural Cd has been measured in the energy range from 0.01 eV up to 10 eV, and resonance parameters have been determined for the 0.178 eV resonance of Cd 113. (auth)

24287 HYPERFINE STRUCTURE MEASUREMENTS IN THE GROUND STATES $^5F_5$, $^5F_4$, $^5F_3$ AND $^5F_2$ OF ^{99}Ru AND ^{101}Ru WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Buettgenbach, S.; Herschel, M.; Meisel, G.; Schroedl, E.; Witte, W. (Bonn Univ. (F.R. Germany). Inst. fuer Angewandte Physik); Childs, W. J. (Argonne National Lab., Ill. (USA); Bonn Univ. (F.R. Germany). Inst. fuer Angewandte Physik). Z. Phys.; 269: No. 3, 189-193(1974).

5 tabs.; 14 refs.

The hyperfine structure of the four lowest levels $^5F_{5,4,3,2}$ of the ^5F ground state multiplet arising from the configuration $4d^75s$ in ^{99}Ru and ^{101}Ru has been studied by the atomic-beam magnetic-resonance technique. After corrections due to the effects of off-diagonal hyperfine mixing, multipole interaction constants are obtained. (GE)

24288 PROTON–NEUTRON-HOLE STATES IN ANTIMONY ISOTOPES POPULATED IN THE BETA DECAY OF ^{128}Sn AND ^{130}Sn. Nunnelley, L. L. Corvallis, OR; Oregon State Univ. (1975). 115p. University Microfilms Order No. 74-29,727.

Thesis (Ph. D.).

^{130}Sn and ^{128}Sn were separated from mixed fission products. The decay of these isotopes was studied with Ge(Li), LEPS, and plastic scintillator detector systems in singles and two-parameter coincidence modes. The decay scheme constructed for ^{128}Sn decay has levels at 0.0 (5^+), 45.7 (4^+), 77.8 (3^+), 152.9 (2^+), 482.2 ($2,3^+$), 635.1 (1^+), and 833.4 (1^+) keV. The decay scheme constructed for ^{130}Sn decay has levels at 0.0 (4^+), 70.6 (3^+), 262.6 ($2,3^+$), 697.0 (1^+), 813.1 ($2,3^+$), and 1042.2 (1^+) keV. It is shown that these levels can be described by neutrons in the $2d_{\frac{5}{2}}$ level coupled with a proton in the $2d_{\frac{5}{2}}$, $2d_{\frac{3}{2}}$, and $1g_{\frac{7}{2}}$ levels. It is possible to arrive at a lower limit of the pairing force. This value of the pairing force was found to be about 40% stronger than an estimate based on the systematics of a large number of nuclei. Core-polarization was used to try to explain the hindrance in the β decay of a $d_{\frac{5}{2}}$ neutron to a $d_{\frac{3}{2}}$ proton. Except for the contribution of the $3s_{\frac{1}{2}}$ neutrons, this core-polarization model was successful. (Diss. Abstr. Int., B)

24289 EVALUATED DECAY SCHEME DATA. Helmer, R. G.; Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID). Nucl. Technol.; 25: No. 2, 258-273(Feb 1975).

The Interlaboratory LMFBR Reaction Rates program involves the determination of rates of neutron-induced reactions by the measurement of gamma-ray spectra from the decay of radioactive reaction products. A goal of the program is to determine certain nonfission reaction rates to an accuracy of ±5% and cer-

tain fission-product rates to ±2½%. These determinations require a knowledge of two nuclear decay scheme parameters: the half-life, and one or more absolute gamma-ray intensities. An evaluation of the experimental data on these parameters was carried out for 20 isotopes, including 6 fission products. The uncertainties in these parameters were also evaluated. (auth)

24290 EXPERIMENTAL INVESTIGATION OF X-RAYS FROM SELECTED RADIOACTIVE SOURCES. Tolea, F. Atlanta; Georgia Inst. of Tech. (1974). vp.

Thesis (Ph. D.).

The product $P_K\omega_K$ of the K-capture probability and the K-fluorescence yield, ω_K, was measured in the electron-capture (EC) decay of 17.7-year ^{145}Pm and 60.14-day ^{125}I by means of K x-ray − γ-ray coincidences with semiconductor detectors. Valences of $P_K = 0.606 \pm 0.025$ and 0.554 ± 0.025 for decay of ^{145}Pm to the 67.2- and 72.4-keV levels in ^{145}Nd, respectively, were determined. The $P_K\omega_K$ ratio to the 67.2- and 72.4-keV levels also was determined independently to be 1.11 ± 0.01. The γ-ray energies were determined more accurately to be 72.4 ± 0.1 and 67.2 ± 0.1 keV, together with a ratio of their relative intensities, $I_{72.4}/I_{67.2} = 3.35 \pm 0.09$. In the decay of ^{125}I, a value of $P_K\omega_K = 0.699 \pm 0.030$ was measured, and a value of $P_K = 0.801$ was calculated from allowed EC theory, from which $\omega_K = 0.873 \pm 0.017$ at Z = 52 was obtained. The relative intensities of the K_β and K_α x rays, K_β/K_α, at Z = 52 and Z = 60 were measured to be 0.231 ± 0.004 and 0.245 ± 0.005, respectively. (Diss. Abstr. Int., B)

24291 ALPHA SCATTERING AND THE NUCLEAR SURFACE. Sumner, W. Q. Seattle; Univ. of Washington (1974). 132p. University Microfilms Order No. 74-29,507.

Thesis (Ph. D.).

The forward-angle elastic scattering cross sections of 42-MeV alpha particles were measured and analyzed for 20 isotopes: ^{40,48}Ca, ^{62,64}Ni, ^{63,65}Cu, ^{64,66,68}Zn, ^{92,94,96,97,98,100}Mo, ^{118}Sn, ^{204,206,208}Pb, and ^{209}Bi. A phenomenological optical model was used to fit these data; it was found that the diffraction radii and the real optical potential (near 2.4 MeV) have a constant relationship, and further that this optical potential is uniquely determined within this region. The potentials agree within 0.01 to 0.02 F with all other similar-quality alpha work in this critical region. By assuming that the real part of the phenomenological optical potential may be constructed by folding the nuclear matter density with an effective nucleon−alpha interaction, it was possible to determine matter densities in the nuclear surface where the density is roughly 1/10 of the central value. By using proton densities from other experiments, neutron densities were determined as well. The isotopic trends of the matter densities were found to be the same as for the strong-absorption radii, with the reliably determined density about 2 F less than the invariant optical potential. (Diss. Abstr. Int., B)

24292 MAGNETIC MOMENTS AND LOW-LYING ENERGY LEVELS IN ^{142}Pr. Hussein, S. G. Hamilton, Ont.; McMaster Univ. (1973). 115p.

Thesis.

Atomic beam magnetic resonance was used to study the 14.6 min isomer and the 19.2 hr ground state in ^{142}Pr. Re-interpretation of previous results for the ground state hyperfine structure, together with some new data, yield the following interaction constants: J = 5/2; A = 65.6 (2) MHz, B = 22(2) MHz. The effect on μ is of minor consequence but the quadrupole moment is tripled in value. With the sign of the moment determined to be positive, the results are: μ = 0.234(1) nuclear magnetons, Q = 0.110(25) barns. The combination of a high resolution ^{141}Pr(d,p) experiment and the analysis of singles and coincidence gamma ray data was used to reveal two new states at 89.7 and 358.1 keV; these are tentatively assigned spins 6⁻ and 7⁻ respectively. The results were interpreted in terms of configuration-mixing between $\pi 2d_{5/2}\nu 2f_{5/2}$ and $\pi 1g_{7/2}\nu 2f_{5/2}$. The resulting wave functions for both the ground state and the isomeric state are quite different from those required to fit the measured magnetic moments. A possible mixing of higher configurations into the low lying states cannot be ruled out. Finally, a mixed-configuration shell model calculation using surface delta interaction was carried out, and its predictions are compared with the experimental results. (MGH)

24293 LEVELS IN ^{97}Tc, ^{99}Tc, ^{101}Tc, AND ^{101}Ru. Cook, W. B. Hamilton, Ont.; McMaster Univ. (1973). 275p.

Thesis.

Levels in ^{97}Tc, ^{99}Tc, ^{101}Tc and ^{101}Ru were studied using the electron capture decay of ^{97}Ru and the beta decays of ^{99}Mo, ^{101}Mo and ^{101}Tc, respectively. The energies and intensities of the gamma rays involved in these decays were measured with high precision by Ge(Li) detectors. Gamma-gamma coincidence experiments with Ge(Li) − Ge(Li) and Ge(Li) − NaI(Tl) spectrometers were used to establish 9 levels in ^{97}Tc, 14 levels in ^{99}Tc, 45 levels in ^{101}Tc and 11 levels in ^{101}Ru. The low energy conversion electron spectrum from the decay of ^{101}Mo was investigated with the Chalk River $\pi\sqrt{2}$ spectrometer. From these data, energies, spins and parities for states in ^{97}Tc, ^{99}Tc, ^{101}Tc and ^{101}Ru were established and interpreted in terms of the shell model. (auth)

24294 MULTIPLE REACTION CORRECTION TO 15 MeV NEUTRON CAPTURE CROSS SECTION IN ^{115}In. Ponnert, K.; Magnusson, G.; Bergovist, I. (Univ. of Lund, Sweden). Phys. Scr.; 10: No. 1-2, 35-41(Jul 1974).

The cross section of the ^{115}In(n,γ)^{116m}In reaction at an incident neutron energy of 15 MeV has been determined by measuring the γ-rays following the decay of the metastable ($T_{½}$ = 54 min) first excited state of ^{116}In. By systematically varying the geometrical arrangement the correction due to secondary low-energy neutrons could be determined. Numerical estimates of the multiple reaction corrections have been made and a comparison with the experimental results indicates a good agreement. The corrected activation capture cross section at 15 MeV is 0.7 ± 0.3 mb which is an order of magnitude lower than previous activation measurements on the same reaction. (auth)

24295 SYSTEMATICS OF THE (d, ^{6}Li) REACTION AND α CLUSTERING IN HEAVY NUCLEI. Becchetti, F.D.; Chua, L.T.; Jänecke, J.; VanderMolen, A.M. (Cyclotron Laboratory, Physics Department, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. Lett. 34: No. 4, 225-227 (27 Jan 1975).

Data for the α−particle pickup reaction (d, ^{6}Li) have been obtained at 35−MeV bombarding energy for even−even nuclei from ^{12}C to ^{238}U. The cross sections for the transitions to the ground states decrease approximately as $1/A_t^3$, where A_t is the target mass. α−particle transfer probabilities have been extracted from the data and are found to be substantially enhanced in heavy nuclei away from shell closures, particularly for deformed nuclei near A≃150. α−particle correlations appear to be related to two−nucleon pairing effects. (auth)

24296 HIGH−SPIN ISOMERS IN ^{91}Nb AND ^{91}Zr VIA ^{6}Li−INDUCED REACTIONS. Brown, B.A.; Lesser, P.M.S.; Fossan, D.B. (State University of New York at Stony Brook, Stony Brook, New York 11794). Phys. Rev. Lett. 34: No. 3, 161-164 (20 Jan 1975).

High-spin levels in ^{91}Nb and ^{91}Zr have been studied with the reactions ^{88}Sr(^{6}Li, 3n)^{91}Nb and ^{88}Sr(^{6}Li, $p2n$)^{91}Zr by pulsed−beam−γ, γ−γ, and γ−W (θ) measurements. Isomers were found which agree with theoretical predictions: a $\tau = 5.42 \pm 0.18$−μsec state at 2035 keV in ^{91}Nb, $|(g_{9/2})^2 p_{1/2}, 17/2^-\rangle$, and a $\tau = 6.15 \pm 0.50$−μsec state at (3183) keV in ^{91}Zr, $|(g_{9/2})^2 \times d_{5/2}, 21/2^+\rangle$. The $|g_{9/2}p_{1/2}d_{5/2}, 15/2^-\rangle$ state in ^{91}Zr was located at 2288 keV by a 28.1−keV decay γ ray. (auth)

24297 LOW LYING LEVELS IN ^{124}Sb. Elliott, D. O.; Hopkins, F. F.; Phillips, G. W.; Richard, P. (Texas Univ., Austin (USA). Center for Nuclear Studies). Z. Phys.; 269: No. 2, 89-95(1974).

The level structure of ^{124}Sb is investigated through the ^{124}Sn(p, nγ−γ)^{124}Sb reactions using on-line γ−γ coincidence techniques. A total of 13 levels in ^{124}Sb below 600 keV excitation are identified. In addition, some conclusions regarding spins and parities are made for some of these levels, based on the transitions observed in this work and comparisons with previous data. (auth)

24298 THE DECAY OF ^{115m}In. Hansen, H. H.; de Roost, E.; van der Eijk, W.; Vaninbroukx, R. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Z. Phys.; 269: No. 2, 155-161(1974).

The decay of ^{115m}In has been investigated using accurate counting methods. The emission rate of conversion electrons plus β^--particles was determined with a 4π proportional flow counter. The total and K-shell internal conversion coefficients of the 336-keV γ-ray in ^{115}In were measured by the electron x-ray coincidence method using combinations of a Si surface barrier with a NaI(Tl) detector and of a magnetic β-spectrometer with a high-energy-resolution Si(Li) detector, respectively. The conversion ratio R = K/(L + M + ...) was deduced from electron spectra recorded with the magnetic β-spectrometer. The 336-keV γ-ray emission rate of all used sources was determined with a calibrated NaI(Tl) γ-ray spectrometer. A Ge(Li) detector has been used to determine the relative intensity of the 497 keV γ-ray in ^{115}Sn. As results have been deduced the 336-keV γ-ray emission per decay ($N_{\gamma 1}/N_0 = (45.9 \pm 0.1)\%$), the total internal conversion coefficient ($\alpha = 1.073 \pm 0.014$), the K-shell internal conversion coefficient ($\alpha_K = 0.843 \pm 0.012$), the conversion ratio $R = 3.63 \pm 0.07$, the β^--transition per decay going to the ground state ($N_{\beta 1}/N_0 = (5.0 \pm 0.7)\%$) and to the first excited level in ^{115}Sn($N_{\beta 2}/N_0 = (0.047 \pm 0.002)\%$), and the 497-keV γ-ray emission ($N_{\gamma 2}/N_{\gamma 1} = \pm(0.103 \pm 0.004)\%$). From the obtained internal conversion data it follows that the 336-keV γ-ray transition is of M4 character with an E5 admixture of less than (3.5 ± 1.5)%. The half-life of the isomeric state ^{115m}In has been determined with four different methods. The result is $T_{½} = (4.486 \pm 0.004)$ h. (auth)

24299 GAMMA RADIATION FROM THE GROUND STATE DECAY OF ^{95}Tc. Kraemer, K.; Huber, B. W. (Bochum Univ. (F. R. Germany). Inst. fuer Experimentalphysik). Z. Phys.; 268: No. 3, 333-336(Jun 1974).

The 20-h ^{95g}Tc decay to levels of ^{95}Mo has been investigated by studying γ singles and $\gamma\gamma$ coincidences. The first excited state of ^{95}Mo at 204 keV, previously assumed to be populated in the ^{95m}Tc decay only, is found to be fed by a γ transition of 870 keV deexciting the level at 1,074 keV which is populated in the ^{95g}Tc decay. Moreover, three new γ transitions of 477, 786 and 1,552 keV deexciting the level at 1,552 keV have been found. For the levels at 1.074 and 1,552 keV the range of possible J^{π} assignments could be reduced. (auth)

24300 DECAY OF 8.0-DAY ^{131}I TO LEVELS OF ^{131}Xe AND 11.77-DAY ^{131m}Xe. Meyer, R. A.; Momyer, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.); Walters, W. B. (Maryland Univ., College Park (USA). Dept. of Chemistry). Z. Phys.; 268: No. 4, 387-390(Jul 1974).

The decay characteristics of ^{131}I have been determined with high accuracy. The total branch from ^{131}I to ^{131m}Xe has been measured to be 1.086 ± 0.007%. The half-life of ^{131m}Xe has been measured as 11.770 ± 0.012 days. The γ-ray spectrum has been determined, and new transitions at 85.92, 232.17, 295.83, 302.44, and 449.57 keV have been established. The position, spin and parity were established for a $9/2^-$ level at 341.140 keV, and spin and parity of $7/2^-$, established for a level at 666.921 keV. The log f_1t for the unique first-forbidden β transition from $7/2^+$ ^{131}I to $11/2^-$ ^{131m}Xe has been calculated to be 9.78. (auth)

24301 TEMPERATURE DEPENDENCE STUDY OF THE ALIGNMENT RELAXATION OF ^{109}Cd NUCLEI IN 469 keV, $11/2^-$ STATE PRODUCED BY THE REACTION ^{109}Ag(p,n)^{109}Cd*. Rinsdorf, E. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Naturwissenschaftliche Fakultaet). 10 May 1972. 52p. (In German). INIS.

The temperature dependence of the alignment relaxation of the ^{109}Cd nuclei in the 469 keV, $11/2^-$ state produced by the nuclear reaction ^{109}Ag(p,n)^{109}Cd* was determined by stroboscopic observation of the Larmor precession. The projectile energy was $E_p = 10$ MeV. The suitable target of natural Ag (99.9%) could be heated up in an oven to about 1,000°C. The destruction of the alignment was explained by the interaction of a fluctuating electric field gradient with the electric quadrupole moment of the ^{109}Cd*. The fluctuations of the field gradient are assumed to be caused by the diffusion of defects or that of Cd* itself. (GE)

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Refer also to abstracts 24243 and 24295.

24302 (COO-1779-152) GAMMA-RAY SPECTROSCOPY OF EXCITED STATES IN ^{177}Hf AND ^{182}W. Jeltema, B. D. (Michigan State Univ., East Lansing (USA). Dept. of Chemistry). 1974. 94p. Dep. NTIS $7.75.

Thesis.

The deformed nuclei ^{177}Hf and ^{182}W were investigated via γ-ray spectroscopic techniques. The EC-β^+ decay of ^{177}Ta to ^{177}Hf was investigated in γ-ray singles and $\gamma-\gamma$ coincidence spectroscopy. Thirteen energy levels in ^{177}Hf were deduced; four levels and fourteen γ rays associated with ^{177}Ta decay were unknown from previous NaI(Tl) work. Log-ft values were assigned to the decay, and multipolarities of several transitions were assigned with use of earlier conversion electron data. The ^{182}W level scheme was investigated primarily by in-beam γ-ray spectroscopy. A total of 59 excited states were placed by use of three-parameter ($\gamma-\gamma-t$) coincidence data. Eleven rotational bands were deduced in this investigation, and all were given collective or particle assignments. The ground-state rotational band was seen at least to spin 12, and the rotational band based on a 1.4-μs isomer was established to spin 15. Decay patterns of some bands are explained qualitatively in terms of configuration mixing, and β-, γ-, ground-band mixing calculations were carried out in an attempt to explain the apparent perturbations present in those three bands. The in-beam study of ^{182}W indicated that errors exist in the accepted decay scheme for 64-h ^{182m}Re. Therefore, a brief study of this decay was also carried out. Two-parameter $\gamma-\gamma$ coincidence data were collected, and γ-ray intensities in the region from 84 keV to 360 keV were measured. A level scheme consistent with the decay and in-beam γ-ray data was established, and log-ft values were assigned. (28 figures, 8 tables) (auth)

24303 (JINR-6-7691) QUANTUM CHARACTERISTICS OF THE ^{149}Gd LEVELS. Budzynski, M.; Ion-Mikhai, R.; Morozov, V. A.; Fuya, Kh.; Muminov, T. M.; Kholbaev, I.; Subotovich, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 17p. (In Russian). INIS.

Gamma-gamma correlations were measured on the following cascades: (187-165), (652-165), (862-165), (388-652), (853-352), (388-817), and (388-652-165) Kev. Spins of the following levels were established: 352 Kev $-3/2$, 817 Kev $-5/2$, 1026 Kev $-3/2$, and 1205 Kev $-5/2$. The multipolarity of a series of gamma transitions was determined more accurately. (tr-SJR)

24304 AN INVESTIGATION OF THE ODD-A RARE-EARTH NUCLEI USING ROTATIONAL MODELS. Hess, C. T. (Maine Univ., Orono (USA)); Koshel, R. D. (Ohio Univ., Athens (USA)). Nucl. Phys., A; 235: No. 2, 378-396(16 Dec 1974).

With the help of recently compiled data for band-head energies of 53 odd-A rare-earth nuclei, rotational models for strongly deformed nuclei have been used to determine the variation of deformations, spin-orbit parameter κ and the l^2 parameter, μ, in these nuclei. The deformation is found to be consistent with experimental deformations within 20%. The spin-orbit parameter, κ, is found to vary from 0.037 up to 0.070, a 25% variation from Nilsson's 0.050. The l^2 parameter, μ, is found to vary from 0.30 up to 0.71, a 30% variation from Nilsson's 0.45. The trends observed in the values of spin-orbit strength C indicate a correlation with deformation, δ. Simultaneous shifts of the l^2 strength D for neutron numbers 95-97 and 101-103 may be interpreted as a sudden shift in the squareness of the potential well, possibly caused by shell filling. Inclusion of hexadecapole deformation greatly improves the band-head energies for the mass region $150 \leqq A \leqq 165$. (auth)

24305 STUDY OF ISOMERIC STATES OF $^{178}_{71}Lu_{107}$ FROM THE ^{181}Ta(n,α)^{178m}Lu, ^{178}Lu REACTIONS AT THERMAL ENERGY. Alam, J.; Sehgal, M. L. (Aligarh Muslim Univ. (India). Dept. of Physics). Nucl. Phys., A; 235: No. 2, 307-314(16 Dec 1974).

The cross sections for the production of 25-min and 5-min activities due to the isomeric states of ^{178}Lu, produced by the ^{181}Ta(n,α) reaction, have been measured at thermal neutron energy. From a study of $\sigma_{25\text{min}}(n,\alpha)/\sigma_{5\text{min}}(n,\alpha)$, an attempt has been made to assign the 25-min and 5-min half-lives to the respective isomeric states of ^{178}Lu. The energy difference between the isomeric states and possible spin assignments have been deduced. (auth)

24306 ON-LINE SEPARATION OF THULIUM ISOTOPES. Putaux, J. C.; Obert, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Aguer, P. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Nucl. Instrum. Methods; 121: No. 3, 615-616(1 Nov 1974).

For the first time thulium was separated from erbium on the on-line ISOCELE separator. ^{157}Tm [half-life (200 ± 25) s] was identified. (auth)

24307 MEASUREMENT OF THE PARITY NON-CONSERVATION IN NUCLEAR FORCES IN ^{75}As, ^{171}Tm, AND ^{175}Lu AND OF THE POLARIZED BREMSSTRAHLUNG FROM ^{51}Cr, ^{170}Tm, ^{177}Lu, AND ^{198}Au. Kuphal, E.; Dewes, P.; Kankeleit, E. (Technische Univ. Darmstadt (F.R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 234: No. 2, 308-330(2 Dec 1974).

The circular polarization P of γ-rays from unpolarized sources of ^{75}Se, ^{171}Er, and ^{175}Yb of strengths ≲500 Ci was measured with a Compton polarimeter of the radial transmission type. Eight NaI crystals and a four-fold current integration system were used to record the data in four independent channels simultaneously. The results are: $P = -(1.8 \pm 6.0) \times 10^{-5}$ for the 401-keV transition in ^{75}As (the experimental error is $\pm 1.5 \times 10^{-5}$, the remaining part is due to the uncertainty in the decay scheme of ^{75}Se), $P = (0.8 \pm 1.5) \times 10^{-4}$ for the 296-keV and 308-keV transitions in ^{171}Tm, and $P = (5.7 \pm 0.8) \times 10^{-5}$ for the 396-keV transition in ^{175}Lu. The last value confirms the parity nonconservation in nuclear forces. The polarimeter was calibrated with bremsstrahlung from ^{170}Tm. The correction for polarized bremsstrahlung was given special attention. Correction factors are derived for ^{51}Cr, ^{177}Lu, and ^{198}Au from a comparison of the measured and calculated bremsstrahlung yields. (auth)

24308 RADIATSIONNYE PROTSESSY V ATOMNYKH YADRAKH. (Radiation Processes in Atomic Nuclei). Begzhanov, R. B.; Belen'kii, V. M.; Abdurakhmanov, S. R.; Usharov, V. K. Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1973). 243p.

Material on the physical characteristics of excited states of deformed even-even nuclei of the rare earths and actinides is presented. Energy level schemes, electromagnetic moments, and probabilities of E2 transitions between states of positive parity are given. The probabilities of EO transitions with levels of negative parity and the ratio of M1 and E2 components in mixed M1 + E2 transitions are also reported. For mixed M2 +

E1 transitions with levels of negative parity to levels of positive parity the ratio of E1 and M2 components are given. (tr-auth)

24309 E1-M2-E3 MIXING OF THE 1241.7 keV TRANSITION IN ^{174}Yb. Loebner, K. E. G.; Mirza, J. A. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Department). Z. Phys.; 269: No. 4, 407-409(Sep 1974).

2 tabs.; 16 refs.

The half-life of the $I,K^{\pi} = 2,2^-$ state at 1,318 keV in ^{174}Yb has been measured in the ^{173}Yb(n,γ) reaction to be 0.486 ± 0.015 ns. This half-life determines the absolute transition probabilities of the gamma-ray transitions to the ground-state rotational band, yielding the following hindrance factors relative to the Weisskopf estimate: $F_w(M2; 2,2^- \rightarrow 0,0^+) = 350$; $F_w(M2; 2,2^- \rightarrow 2,0^+) \geq 77$; $F_w(M2; 2,2^- \rightarrow 4,0^+) > 740$; $F_w(E1; 2,2^- \rightarrow 2,0^+) = 4.5 \times 10^6$; $F_w(E3; 2,2^- \rightarrow 2,0^+) \approx 0.1$; $F_w(E3; 2,2^- \rightarrow 4,0^+) \approx 0.4$. These data are compared to analogous transitions in neighboring nuclei. (auth)

24310 INVESTIGATION ON THE PARITY MIXING OF THE 482 keV TRANSITION IN ^{181}Ta BY USE OF A BACKSCATTERING POLARIMETER. Schmidt, G.; Simons, L. M. (Bonn Univ. (F.R. Germany). Inst. fuer Strahlen- und Kernphysik). Z. Phys.; 269: No. 4, 421-424(Sep 1974).

3 figs.; 28 refs.; 1 tab.

The circular polarization of the 482-keV gamma radiation in ^{181}Ta was remeasured by use of a Compton backscattering polarimeter with the single pulse counting technique. The measurements yielded $P_c = -(7.0 \pm 6.6) \times 10^{-6}$, in good agreement with the results of other groups. (GE)

24311 ASSESSMENT OF THE COMPOUND NUCLEUS MECHANISM FOR 14 MeV NEUTRON-INDUCED REACTIONS IN RARE-EARTH REGION OF NUCLEI. Rama Prasad, P.; Rama Rao, J.; Kondaiah, E. (Tata Inst. of Fundamental Research, Bombay). Indian J. Pure Appl. Phys.; 12: No. 9, 640-644(Sep 1974).

Experimentally measured cross sections for (n,2n), (n,α), and (n,p) reactions at (14.2 ± 0.2) MeV in a number of rare-earth isotopes were compared with the theoretical estimates based on the compound-nucleus theory of nuclear reactions to draw inferences on the validity of the theoretical model. It was shown that, in this mass region of nuclei, (n,2n) reactions more or less follow the compound-nucleus mechanism, while (n,p) reactions definitely take the direct interaction path. The (n,α) reactions represent a median situation with admixtures of both types of interactions. (auth)

24312 INTERACTIONS OF PROTONS WITH HEAVY NUCLEI AT 200 GeV. Florian, J. R. Seattle; Univ. of Washington (1974). 136p. University Microfilms Order No. 74-29,413.

Thesis (Ph. D.).

Nuclear track emulsions were exposed to 200-GeV protons at the National Accelerator Laboratory. One of the emulsion plates was loaded with granules of tungsten. Interactions in the emulsion and with the tungsten granules were located, and angular measurements were made on the shower particles. The average number of heavily ionizing particles produced on tungsten was found to be 29.4 ± 4.3. Moreover, the average multiplicity of charged shower particles is 16.8 ± 3.8, about twice as large as that for p-p interactions at the same energy. The corresponding values for the emulsion are 7.2 ± 0.5 and 13.9 ± 0.6 for the multiplicity of heavily ionizing and shower particles. Both the shower multiplicity and angular distribution as a function of target mass were analyzed. Also studied was the dependence of these quantities on the nuclear response (number of heavily ionizing tracks). These data were compared to recent models of intranuclear cascading, and were found to be in excellent agreement with the energy flux cascade theory of Gottfried. (Diss. Abstr. Int., B)

24313 NUCLEAR CHARGE DISTRIBUTION OF ^{169}Tm. Deci, E. C. Binghamton, NY; State Univ. of New York (1973). 111p. University Microfilms Order No. 73-21,068.

Thesis (Ph. D.).

The distribution of electrical charge in the nucleus of ^{169}Tm was determined by measurement of the energies of the x rays of muonic atoms of ^{169}Tm. The values of the energies of the K x rays and the L x rays were calculated from a model assuming an anisotropic Fermi distribution of charge, and compared to the measured values. The assumed distribution is a function of three parameters: a half radius, a surface thickness, and a measure of the anisotropy. The values of the parameters were varied to find the values that gave the best agreement with the measured spectrum. The rotational model of the nucleus was assumed in the calculations. It was necessary to refine the calculation by including the effects of states beyond the one in which the muon was orbiting. (Diss. Abstr. Int., B)

24314 NUCLEAR STRUCTURE OF ^{151}Sm. Nelson, D. E. Hamilton, Ont.; McMaster Univ. (1973). 132p.

Thesis.

An experimental study of the low lying levels of the nucleus ^{151}Sm was made using the single particle transfer reactions 1) ^{152}Sm(d,t)^{151}Sm, 2) ^{152}Sm(^{3}He,α)^{151}Sm, 3) ^{150}Sm(d,p)^{151}Sm, 4) ^{151}Sm(d,p)^{152}Sm, 5) ^{151}Sm(d,t)^{150}Sm and 6) ^{151}Sm(^{3}He,α)^{150}Sm. Also, inelastic scattering and Coulomb excitation experiments were performed on targets of ^{151}Sm. The information obtained from these experiments when combined with the results of previous studies of the decay of ^{151}Pm, has allowed definite spin and parity assignments to be made for about 15 levels in ^{151}Sm, and has put limitations on the possible assignments for several others. The level scheme obtained is compared with the predictions of the Nilsson model, including the effects of Coriolis and $\Delta N = 2$ mixing. (auth)

24315 NEUTRON RESONANCE SPECTROSCOPY: THE SEPARATED ISOTOPES OF Dy. Liou, H.I.; Hacken, G.; Rainwater, J.; Singh, U.N. (Columbia University, New York, New York 10027). Phys. Rev. C 11: No. 2, 462-473 (Feb 1975).

Results are given for the neutron resonance parameters of the Dy isotopes (160 to 164) based on 202.05-m transmission and 39.536-m capture self-indication flight path time-of-flight measurements using the Columbia-Nevis synchrocyclotron. The $A = 161$ to 164 samples were ~ 92 to 98% enriched. The ^{160}Dy sample was 69.5% enriched. We give E_0 and (g) Γ_n^0 values for: ^{160}Dy—64 levels to 2 keV; ^{161}Dy—251 levels to 1 keV; ^{162}Dy—142 levels to 16 keV; ^{163}Dy—114 levels to 1 keV; ^{164}Dy—116 levels to 21 keV. The $< \Gamma_\gamma >$ values and (numbers) of Γ_γ values were 108 meV (9), 112 meV (26), 112 meV (16), 113 meV (39), and 114 meV (5), respectively. A shape fit to the strong asymmetric level at 147 eV in ^{164}Dy gave $R' = 7.5$ fm. The $l = 0$ strength functions, $10^4 S_0$, are (2.00 ± 0.36), (1.73 ± 0.17), (1.88 ± 0.25), (2.02 ± 0.30), and (1.70 ± 0.25), respectively. Using our threshold sensitivities for level detection vs E_n and various statistical tests, indicates the following numbers of missed s levels to the E_{max} where most s levels were seen as: ^{160}Dy—2 to 900 eV; ^{161}Dy—5 to 140 eV; ^{162}Dy—2 to 3 keV and 6 to 4.5 keV; ^{163}Dy—2 to 220 eV; and ^{164}Dy—2 to 5 keV. No p levels were included for 160, 161, 163, but a few were present for 162 and 164, giving $10^4 S_1 = (1.1 \pm 0.4)$ (^{162}Dy) and (1.3 ± 0.3) (^{164}Dy). Various statistical tests suggest where the missed s levels should be located to give good agreement with the tests, giving $< D_0 > = (27.3 \pm 1.7)$, (2.67 ± 0.13), (64.6 ± 1.9), (6.85 ± 0.54), and (147 ± 9) eV, respectively. (auth)

24316 ANGULAR CORRELATION BETWEEN K AND L x RAYS IN TANTALUM. Zalutsky, M.R.; Macias, E.S. (Department of Chemistry, Washington University, St. Louis, Missouri 63130); Catz, A.L. Phys. Rev. A 11: No. 1, 75-78 (Jan 1975).

Angular correlations between K and L x rays in Ta obtained from the electron-capture decay of ^{181}W were measured using two different experimental systems. High-resolution Si(Li) x-ray detectors were used to detect L x rays. K x rays were detected with a high-resolution Ge(Li) spectrometer in one experiment and a NaI(Tl) crystal in the other experiment. The adopted values for the $K\alpha_1-Ll$, $K\alpha_1-L\alpha_{1+2}$, and $K\alpha_1-L\beta$ cascades are $A_{22} = (24 \pm 3) \times 10^{-2}$, $A_{22} = (3.2 \pm 0.2) \times 10^{-2}$, and $A_{22} = (3.4 \pm 0.9) \times 10^{-2}$, respectively. The results for the $K\alpha_1-L\alpha$ cascade agree with theoretical predictions, but the results for the $K\alpha_1-Ll$ and $K\alpha_1-L\beta$ cascade are slightly lower than predicted. (auth)

24317 OBSERVATION OF A 2 S ACTIVITY FROM IRRADIATION OF RHENIUM WITH HIGHER-ENERGY DEUTERONS. Jahn, P.; Mayer-Boericke, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Naturforsch., a; 29: No. 2, 363(Feb 1974).

Following the irradiation of rhenium with deuterons of 45 to 80 MeV, a 184-keV γ-line was observed which decayed with a half-life of 2.0 ± 0.2 s. A tentative assignment of this activity to ^{183}Os is derived on the basis of yield ratios. (auth)

24318 CONVERSION ELECTRONS OF ^{168}Er FOLLOWING NEUTRON CAPTURE. Olma, B. J.; von Egidy, T. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Department). Z. Phys.; 268: No. 4, 379-385(Jul 1974).

The reaction ^{167}Er(n,e)^{168}Er has been measured with the beta spectrometer at the FRM reactor in Munich and a new multiwire detector. One hundred and one transitions between 1 and 6.7 MeV have been found. Sixty-three multipolarities could be determined. The spin and parity assignments in the level scheme of Michaelis et al. have been verified by this measurement. Seven new levels and two new rotational bands have been observed. (auth)

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Refer also to abstracts 24243, 24245, 24257, 24289, 24291, 24295, 24307, 24334, 24335, and 24363.

24319 ELECTRIC MONOPOLE COMPONENT IN THE $2^{+\prime} \rightarrow 2^{+}$ TRANSITION IN ^{192}Pt. Voinova, N. A.; Kaminker, D. M.; Sergeenkov, Yu. V. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). Nucl. Phys., A; 235: No. 1, 123-134(9 Dec 1974).

Angular correlation measurements of K- and L-conversion electrons following the decay ^{192}Ir → ^{192}Pt have been made using a spectrometer with Ge(Li) and Si(Li) detectors. Absolute and relative internal conversion coefficients of transitions in ^{192}Pt were measured, using an ICC and prism β-spectrometers, to ~2%, and values of δ_γ were determined from the relative ICC. The experimental values measured in the study, A_{22}(K296γ316) = 0.138 ± 0.010, A_{22}(L296γ316) = 0.125 ± 0.013, α_k (296) = 0.0711 ± 0.0011, K/L_{III} = 9.65 ± 0.13 with δ_γ = +5.4 ± 0.2, were employed for determining the E0/E2 amplitude ratios of conversion transitions, q(E0/E2), and the penetration parameter λ of the M1 component for the $2^{+\prime} \rightarrow 2^{+}$ (296 keV) transition in ^{192}Pt. The angular correlation measurements of L-conversion electrons enabled the elimination of one of two ranges of values of q and λ usually obtained. Analysis of the $e_L\gamma$ angular correlation for the determination of the E0 component in the transition was carried out. As a result, q = +0.04 ± 0.05 with λ = −4.5 ± 3.5 was obtained for the 296-keV transition. In this case, ρ(E0) = 0.004 ± 0.005 agrees with ρ(E0) = +0.006 determined theoretically by Kumar and Baranger for the $2^{+\prime} \rightarrow 2^{+}$ transition. (auth)

24320 NUCLEAR STRUCTURE CALCULATIONS WITH A DENSITY-DEPENDENT FORCE IN ^{208}Pb. Ring, P. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.); Speth, J. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 235: No. 2, 315-351(16 Dec 1974).

Excitation energies and excitation probabilities in ^{208}Pb of the low-lying states as well as of strongly collective high-lying states (generalized multipole resonances) are calculated, using a large configuration space and a density-dependent interaction. Within the extended theory of finite Fermi systems moments of excited states and transition probabilities between excited states are calculated. The theoretical results are in fair agreement with the experimental values. (auth)

24321 CORRECTION FOR A RESONANCE-CAPTURE COMPONENT IN THERMAL-NEUTRON-CAPTURE GAMMA-RAY SPECTRA. Loper, G. D.; Thomas, G. E.; Bollinger, L. M. (Argonne National Lab., Ill. (USA)). Nucl. Instrum. Methods; 121: No. 3, 581-587(1 Nov 1974).

The paper outlines a method for extracting accurate values of the absolute intensities of thermal-neutron-capture gamma rays from spectra that have a resonance-capture contaminant. The method depends on a measurement of the spectra for two neutron fields that have a known ratio of the relative flux of epithermal neutrons. This approach is applied to a study of ^{197}Au(n,γ)^{198}Au. The derived absolute values of the transition intensities for thermal-neutron capture provide an accurate and useful intensity standard for gamma rays in the energy range 6 to 6.5 MeV. (auth)

24322 STATIC NUCLEAR DEFORMATION AND THE TOTAL REACTION CROSS SECTION. Alexander, J. M.; Vaz, L. C.; Lin, S. Y. (State Univ. of New York, Stony Brook). Phys. Rev. Lett.; 33: No. 25, 1487-1490(16 Dec 1974).

An empirical study is made of the total reaction cross sections for ^{4}He reactions with ^{208}Pb, ^{209}Bi, ^{233}U, and ^{237}Np. Systematic differences are revealed that are attributed to the effects of nuclear deformation. This behavior can be accounted for by a reduction of the average interaction barrier by 0.3 to 0.6 MeV or by an increase in the width of the spectrum of barriers by 0.4 to 0.7 MeV. (auth)

24323 SPECTRUM SHAPE AND NUCLEAR CORE MATRIX ELEMENTS FOR THE BETA-DECAY OF ^{206}Tl. Wiesner, W. (Heidelberg Univ. (F.R. Germany). Naturwissenschaftliche Gesamtfakultaet). 7 Jun 1972. 39p. (In German). INIS.

9 figs.; 2 tabs.; 42 refs.; with app. Available from the library of Heidelberg Univ.

In the β decay of ^{206}Tl, the β spectrum and the half-life of the $0^- \rightarrow 0^+$ transition were measured. A 4π semiconductor spectrometer with lithium-drifted silicon detectors was used to determine the spectrum shape. The measured β spectrum was corrected for the effect of the disappearing outer bremsstrahlung which is produced in the semiconductor detectors. The spectrum factor obtained from the measurements can be fitted to the expression C(W) = K(I + aW), where a = (−0.020 ± 0.002)/mc^2, and thus shows only small deviations of the β spectrum from the statistical shape. This result is contrary to another measurement in which strong deviations from the statistical shape were observed. In order to compare the experimental results with the theory within the framework of the shell model, the core matrix elements of the $0^- \rightarrow 0^+$ transition were calculated by means of single-particle wave functions. From this a theoretical ft value, log ft = 6.1, is obtained as compared to the experimental value, log ft = 5.3. The experimental shape of the spectrum factor is, however, well reproduced by the theoretical shape calculated from the core matrix elements. (GE)

24324 INVESTIGATIONS ON THE INTERNAL CONVERSION OF ISOMERIC TRANSITIONS WITH HIGH MULTIPOLARITY IN ^{109}Ag, ^{125}Te, ^{191}Os AND ^{193}Ir. Loeweneck, P. (Heidelberg Univ. (F.R. Germany). Naturwissenschaftliche Gesamtfakultaet). 14 June 1972. 56p. (In German). INIS.

18 figs.; 14 tabs.; 41 refs. Available from the library of the Heidelberg Univ.

At the Heidelberg $\pi/2\sqrt{13}$ beta spectrometer the conversion electron spectra were investigated for the isomeric transitions in ^{109}Ag (E3 ± 0.01% M4), ^{125}Te (M4 ± 0.03% E5), ^{191}Os (M3 + (0.3 ± 0.03)% E4, lambda = 9.4 ± 0.5) and ^{193}Ir (M4 + (0.02 ± 0.02)% E5). The comparison between theory and experiment shows that—except for the ^{191m}Os decay—there exist transitions unmixed in the multipoles. The conversion coefficients calculated using different atomic potentials are compared with experiment. With a crystal spectrometer the energy of the isomeric $9/2^- \rightarrow 5/2^-$ transition in ^{191}Os was determined to be 74.380 ± 0.003 keV and the subsequent $5/2^+ \rightarrow 3/2^+$ transition energy in ^{191}Ir to be 129.433 ± 0.002 keV. (GE)

24325 LEVEL STRUCTURE AND γ TRANSITIONS IN ^{202}Hg STUDIED BY THE (n, γ) REACTION. Breitig, D.; Casten, R.F.; Kane, W.R.; Cole, G.W.; Cizewski, J.A. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. C 11: No. 2, 546-560 (Feb 1975).

Several (n, γ) techniques at thermal and resonant neutron energies have been used to investigate the level scheme of ^{202}Hg. Low- and high-energy (n, γ) spectra have been measured at the Brookhaven National Laboratory (BNL) high flux beam reactor using Ge(Li) detectors. Two-parameter coincidence spectra and $\gamma-\gamma$ angular correlation data were taken. Primary transitions from resonance capture in ^{201}Hg were studied with the fast chopper facility at BNL. The combination of these data led to the construction of a detailed level scheme up to about 2 MeV. Twenty-two excited states were found, most of which could be given spins or spin limits. As in ^{200}Hg a systematic behavior of the level population as a function of energy and spin was observed and could be used for spin assignments. Most of the levels, and in particular their γ deexcitations, were not accurately known previously. Of special interest is the observation that the lowest excited 0^+ state is at 1564 keV. Another 0^+ state was discovered at 1643 keV. These findings shed new light on the "extra" 0^+ state in ^{200}Hg at 1029 keV. The systematics of level energies and branching ratios in the Hg isotopes is treated and is found to be suggestive of significant nuclear structure differences as a function of neutron number. In particular, a comparison with model calculations for core-coupled states revealed extensive disagreements for ^{202}Hg, in contrast to the rather satisfactory comparison found in ^{200}Hg. (auth)

24326 POPULATION OF LEVELS IN ^{199}Hg FOLLOWING ^{199}Tl DECAY AND INTERMEDIATE COUPLING CALCULATIONS FOR ^{199}Hg. Mathews, G. J.; Bernthal, F. M.; Immele, J. D. (Departments of Chemistry and Physics and Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824 and Department of Chemistry, University of Maryland, College Park, Maryland 20742). Phys. Rev., C; 11: No. 2, 587-598(Feb 1975).

The electron-capture decay of ^{199}Tl to levels in ^{199}Hg has been reinvestigated. Twenty new transitions are assigned to the ^{199}Tl decay scheme, and the population of two new levels in ^{199}Hg at 750.4 and 1221.2 keV is confirmed. A quasiparticle-phonon coupling model is applied to low-lying levels in ^{199}Hg. Good agreement with experiment is obtained for the eigenvalues, spectroscopic factors, and electromagnetic transition rates and moments by variation of the $f_{5/2}$ neutron energy and by introducing a phenomenological reduction factor in the coupling matrix element. (auth)

24327 FRAGMENTATION OF MAGNETIC DIPOLE STRENGTH IN ^{208}Pb. Lee, T.H.; Pittel, S. (Bartol Research Foundation of the Franklin Institute, Swarthmore, Pennsylvania 19081). Phys. Rev. C 11: No. 2, 607-609 (Feb 1975).

Fragmentation of the $M1$ strength in ^{208}Pb at energies near the (γ, n) threshold is studied. It is shown that the 2p−2h configuration can provide a mechanism for fragmenting the 1p−1h giant $M1$ excitation; however, our results do not predict as much spreading of the $M1$ strength as has been suggested by experiment. The 2p−2h mechanism is also unable to explain the large $M1$ strength recently observed at 4.84 MeV in ^{208}Pb. (auth)

24328 HIGH RESOLUTION (p, p') ON ^{207}Pb AND ^{209}Bi. Wagner, W.T.; Crawley, G.M.; Hammerstein, G.R. (Cyclotron Laboratory and Department of Physics, Michigan State University, East Lansing, Michigan 48824). Phys. Rev. C 11: No. 2, 486-507 (Feb 1975).

The inelastic scattering of protons from ^{207}Pb and ^{209}Bi has been measured with energy resolution on the order of 1/5000. Many states

were observed and a number of weak coupling multiplets were identified. Use of the collective model and weak-coupling theory enabled spin and parity assignments to be made. Calculations for the observed single-particle states with noncentral forces and with core polarization are presented. (auth)

24329 SPECTROSCOPY OF α AND K- AND L-ELECTRON CONTINUA AND L-ELECTRON PICKUP IN ^{210}Po α DECAY. Fischbeck, H. J.; Freedman, M. S. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett.; 34: No. 4, 173-176(27 Jan 1975).

The continuous low-energy electron distributions emitted from K and L atomic shells in a small fraction of ^{210}Po α decays have been measured from 6 to 100 keV. The corresponding complementary α satellite continua have been measured. Electron and α shapes agree well, but disagree with all extant predictions. K and L emission probabilities were determined. About 65% of the L (but very few of the K) electrons ejected are captured into bound states of the α particle. (auth)

24330 NUCLEAR G-FACTORS OF THE 328 keV STATE IN ^{194}Pt, THE 240 keV STATE IN ^{195}Pt, AND THE 356 keV STATE IN ^{196}Pt DETERMINED BY RECOIL-IMPLANTATION INTO IRON AND COBALT HOSTS. Garber, D. A.; Behar, M.; Grabowski, Z. W.; King, W. C. (Purdue Univ., Lafayette, Ind. (USA). Tandem Accelerator Lab.). Z. Phys.; 270: No. 3, 163-167(Oct 1974).

The iron-implantation perturbed-angular-correlation technique (IMPACT) has been used to measure the Larmor precessions of the 328, 240, and 356 keV states of ^{194}Pt, ^{195}Pt, and ^{196}Pt nuclei, respectively, in ferromagnetic iron and cobalt hosts. The observed angular precessions in iron, corrected for the transient field effect, were $\omega\tau_{194}(328) = 0.103 \pm 0.006$ rad, $\omega\tau_{195}(240) = 0.142 \pm 0.012$, and $\omega\tau_{196}(356) = 0.084 \pm 0.010$. For cobalt hosts, the observed Larmor precessions were $\omega\tau_{194}(328) = 0.068 \pm 0.006$, $\omega\tau_{195}(240) = 0.096 \pm 0.012$, and $\omega\tau_{196}(356) = 0.057 \pm 0.013$. Agreement between the g-factors obtained from the measurements in iron hosts and the measurements in cobalt hosts is very good, and a weighted average of the measurements gives $g_{194}(328) = 0.349 \pm 0.031$, $g_{195}(240) = 0.136 \pm 0.013$, and $g_{196}(356) = 0.329 \pm 0.039$. (auth)

24331 ELECTRON CAPTURE RATIOS IN ^{206}Bi. Goverse, S. C.; Kuijper, J.; Blok, J. (Vrije Universiteit, Amsterdam (Netherlands)). Z. Phys.; 269: No. 2, 111-116(1974).

The electron capture decay of ^{206}Bi has been investigated by means of a 4π internal source scintillation spectrometer. The L/K and M/L capture ratios of three levels have been measured and deduced. The Q_{EC} value has been deduced from the L/K capture ratios and is discussed. (auth)

24332 VERY ENERGETIC HEAVY FRAGMENTS FROM RELATIVISTIC HEAVY-ION REACTIONS. Crawford, H.J.; Price, P.B.; Stevenson, J.; Wilson, L.W. (Department of Physics, University of California, Berkeley, California 94720). Phys. Rev. Lett. 34: No. 6, 329-331 (10 Feb 1975).

In bombardments of Au with 25-GeV ^{12}C ions we have studied the energy and angular distribution of fragments with $5 \leq Z \leq 9$ emitted at energies up to ~1000 MeV. Beyond ~150 MeV the spectra change from roughly exponential in energy and isotropic in some forward-moving frame to roughly inverse power law in energy (steepening with increasing Z) and strongly forward peaked in direction. Possible bumps in the angular and energy distributions suggest hydrodynamic effects. (auth)

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Refer also to abstracts 24245, 24257, 24289, 24295, 24308, 24322, and 24335.

24333 (GSI-tr-8/74) EXPERIMENTS TO DISCOVER SPONTANEOUSLY FISSIONING NUCLIDES OF SUPERHEAVY ELEMENTS IN NATURE. Flerov, G. N.; Ter-Akop'yan, G. M.; Skobelev, N. K.; Popeko, A. G.; Ivanov, M. P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F. R. Germany)). Apr 1974. 18p. (In German). INIS.

Translated from JINR P6-7588. Published in: Yadernaya Fizika.

An analysis of the different types of methods used to search for superheavy elements in nature shows that the detection of rare occurrences of spontaneous fissions is the most sensitive and universal method. Large proportional counters for fission fragments and neutron multiplicity counters are described. Upper limits for the concentration of superheavy elements are calculated under the condition that the half-life of the element to be found has a value of 10^9 years, for bismuth hydroxide (2.5×10^{-13} g/g), lead (4×10^{-15}–5×10^{-16} g/g), mercury (1.4×10^{-14}–1.4×10^{-15} g/g) and tungsten (1.4×10^{-14}–2.5×10^{-15} g/g). (GE)

24334 (GSI-tr-18/74) DETERMINATION OF REACTION THRESHOLDS IN THE BOMBARDMENT OF ^{208}Pb AND ^{238}U WITH ^{40}Ar AND ^{52}Cr IONS. Oganesyan, Yu. Ts.; Penionzhkevich, Yu. E.; Gavrilov, K. A. A.; Kim De En. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Aug 1974. 9p. (In German). INIS.

Translated from JINR P7-7863. Published in Yadernaya Fizika.

The dependence of the formation cross-sections for fission fragments of thin ^{208}Pb and ^{238}U targets on the energy of the ^{40}Ar and ^{52}Cr ions is investigated. From the determined function the Coulomb barrier of the interacting nuclei and their effective interacting radius is determined. The latter proved to be constant for all investigated reactions and had a value of 1.44 ± 0.02 fermi. The data obtained are compared with results of various calculations. (GE)

24335 (GSI-tr-19/74) SYNTHESIS OF NEUTRON-DEFICIENT ISOTOPES OF FERMIUM, KURCHATOVIUM AND ELEMENT 106. Oganesyan, Yu. Ts.; Tret'yakov, Yu. L.; Ilinov, A. S.; Demin, A. G.; Pleve, A. A.; Tret'yakova, S. P.; Plotko, V. M.; Ivanov, M. P.; Danilov, N. A.; Korotkin, Yu. S. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Aug 1974. 10p. (In German). INIS.

Translated from JINR D7-8099.

The possibility of synthesizing heavy elements with an atomic number of over 100 is discussed, namely, the possibility of bombarding the magic nuclei of Pb and neighboring nuclei with ions where A > 40. Taking the example of the reactions ^{206,207,208}Pb $(^{40}$Ar,xn$)^{244,246}$Fm, it is shown that the largest cross-section corresponds to a small number of 2 to 3 emitted neutrons. New isotopes of the element 104 were synthesized by this method in the reaction Pb + ^{50}Ti. In the reaction ^{207,208}Pb + ^{54}Cr, a new, spontaneously fissioning emitter was produced with a half-life of a few milliseconds. The experimental results on the whole justify the assumption that the observed effect is due to the decay of element 106. (GE)

24336 (GSI-tr-20/74) EXPERIMENTS TO DISCOVER SPONTANEOUSLY FISSIONING NUCLIDES OF SUPERHEAVY ELEMENTS IN NATURE. P. 3. Search for Superheavy Elements in Iron-Manganese Concretions. Flerov, G. N.; Vyropaev, V. Ya.; Getskin, L. S.; Popeko, A. G.; Skobelev, N. K.; Ter-Akop'yan, G. M.; Tsy, P. P. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). Sep 1974. 9p. (In German). INIS.

Translated from JINR P6-7856. Published in Yadernaya Fizika.

Superheavy elements were searched for in iron-manganese concretions. Distillates from the concretions and products of chemical enrichment processes for heavy elements were also investigated. The limiting values T/C for the heavy homologues of mercury, thallium, lead, and bismuth were determined for the investigated substances. (GE)

24337 (JINR-E7-8298) PRODUCTION OF ^{14}Be IN HEAVY ION REACTIONS. Artynkh, A. G.; Avdeichikov, V. V.; Gridnev, G. F.; Mezentsev, A. N.; Mikheev, V. L.; Volkov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

In bombarding ^{232}Th with 145-MeV ^{15}N ions, the production of ^{14}Be nuclei was detected. The ^{14}Be yield corresponds to the upper limit in its production cross section ($\sim 3 \times 10^{-5}$ mb/sr) determined in the work of Artukh et al. [Phys. Lett., 33B, 407 (1970)] An enhancement in the experimental sensitivity as compared with that work was achieved by adding the time-of-flight technique to the magnetic analysis and ΔE, E technique. (2 figures) (auth)

24338 RATIO OF THE TERNARY-TO-BINARY FISSION CROSS SECTIONS INDUCED BY THERMAL AND RESONANCE NEUTRONS IN ^{241}Pu. Wagemans, C. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Deruytter, A. J. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Nucl. Phys., A; 234: No. 2, 285-300 (2 Dec 1974).

The ternary-to-binary fission cross section ratio (T/B) was determined for ^{241}Pu for neutron-induced fission in the energy region from 0.01 eV to 50 eV. The ternary and binary fission time-of-flight spectra were recorded at an 8.1-m flightpath at the CBNM Linac with a bank of four large gold-silicon surface-barrier detectors viewing a 1 mg/cm^2 ^{241}Pu target. The ternary alpha pulse-height spectrum in the neutron energy region of interest was checked continuously. From the time-of-flight spectra the ratios of the areas of the strongest resonances in ternary and in binary fission were calculated; in the neutron energy region from 0.01 to 0.5 eV ratios were calculated for 18 zones throughout the spectrum. In the energy region from 1 to

50 eV the T/B ratio varies significantly from resonance to resonance, allowing a classification into a "high" and a "low" group. Although the statistical accuracy is poorer in the region below 1 eV, it is deduced from these T/B data that the 0.260 eV resonance probably belongs to the "high" group and also that there is only a slight difference between the T/B value at 0.260 eV and at thermal energy. These T/B values are correlated with the resonance spin, J, in terms of the channel theory of fission. (auth)

24339 FISSION-IN-FLIGHT TECHNIQUE AND THE SLOWING-DOWN OF RECOIL NUCLEI IN GASES. Bodo, E.; Galeriu, D.; Marinescu, M.; Poenaru, D.; Vilcov, I.; Vilcov, N. (Institutul de Fizica Atomica, Bucharest (Romania)); Gangrsky, Yu. P.; Hien, P. Z. (Joint Inst. for Nuclear Research, Dubna (USSR)); Tsipenyuk, Yu. M. (AN SSSR, Moscow. Inst. Fizicheskikh Problem). Nucl. Instrum. Methods; 121: No. 2, 379-383(15 Oct 1974).

The study of heavy nuclei recoil dynamics in gas is required by experiments of fission-fragment angular distributions measured with the fission-in-flight technique. The dependence of the number of recoiling nuclei on the collection distance and the dependence of the number of recoiling nuclei on the gas pressure were measured for a given pressure value and for a given collection distance, respectively. The experimental data are discussed in terms of two slowing-down processes, the pure electronic ($dE/dx \sim kv$) and the pure nuclear ($dE/dx \sim$ const), which fit this intermediate recoil velocity range ($v/c \leq 2 \times 10^{-3}$). In the case of the dependence of the number of recoiling nuclei on the collection distance, the agreement is considerably improved when the angular distribution of the recoil products is taken into account. (auth)

24340 MEASUREMENT OF ABSOLUTE FISSION RATES. Grundl, J. A. (National Bureau of Standards, Washington, D. C.); Gilliam, D. M.; Dudey, N. D.; Popek, R. J. Nucl. Technol.; 25: No. 2, 237-257(Feb 1975).

The capability to measure absolute fission rates per nucleus at a remote laboratory site [the Coupled Fast Reactivity Measurement Facility (CFRMF) at Aerojet Nuclear Company] was established to a precision level of better than ±1% and sustained at that level for a period of two years. Double fission ionization chambers and solid-state track recorders were used in a series of irradiations designed to calibrate fission activation detectors used for reactor fuels and materials dosimetry. The array of reference and working fissionable deposits involved in the measurements included five isotopes: ^{239}Pu, ^{235}U, ^{238}U, ^{237}Np, and ^{234}U. Isotopic masses for the fissionable deposits were determined from interrelated components of mass assay: relative and absolute alpha counting, fission comparison counting in thermal-neutron beams, mass spectrometry, and quantitative deposition employing solutions of known fissionable element concentration. Absolute accuracies for the fission rates per nucleus measured in CFRMF are in the range of ±1.5 to ±2.5%, and are dominated by uncertainties in the fissionable deposit masses. Fission cross-section ratios for the CFRMF central spectrum are (1.000 : 1.145 ± 0.017 : 0.0485 ± 0.007 : 0.354 ± 0.008) for (^{235}U : ^{239}Pu: ^{238}U: ^{237}Np), respectively. (auth)

24341 FISSION-PRODUCT-RATE MEASUREMENTS AND YIELDS. Dudey, N. D. (Argonne National Lab., IL); Popek, R. J.; Greenwood, R. C.; Helmer, R. G.; Rogers, J. W.; Kellogg, L. S.; Zimmer, W. H. Nucl. Technol.; 25: No. 2, 294-304(Feb 1975).

Measurements of the reaction rates for gamma-active fission products and yields from fission of ^{238}U, ^{235}U, ^{239}Pu, and ^{237}Np irradiated in the Coupled Fast Reactivity Measurements Facility and engineering mockup critical assembly neutron fields are reported. The fission products ^{95}Zr, ^{103}Ru, and ^{140}Ba were measured by gamma-ray spectroscopy at four independently calibrated laboratories. It is concluded that each laboratory is capable of measuring absolute reaction rates to an accuracy of less than ±2%. Fission yields of six gamma-active nuclides are reported. The primary objective of this work is to demonstrate the capability of measuring fission rates within fast-reactor environments to accuracies approaching 2.5%. It is shown that foil-activation techniques are capable of this accuracy under ideal conditions. Even greater accuracy is possible for relative measurements which utilize the identical gamma-ray detector and nuclear decay data used to measure the fission yield. The fission yields measured in this study are compared to other measurements, and it is found that the ENDF/B, Version IV, yields are, in general, consistent to within ±2% of the results for ^{235}U, ^{238}U, and ^{239}Pu. (7 tables) (auth)

24342 HIGH FLUX LEVEL REACTION RATE MEASUREMENTS. Zimmer, W. H. (Atlantic Richfield Hanford Co., Richland, WA); Heinrich, R. R.; Kellogg, L. S.; Matsumoto, W. Y. Nucl. Technol.; 25: No. 2, 289-293(Feb 1975).

High-flux-level reaction rates are measured from the gamma-ray emission analysis of activated foils. These foils are analyzed nondestructively to eliminate error due to dissolution, dilution, and/or chemical separation. Signal-to-noise enhancement is achieved through the exclusive use of lithium-drifted germanium detectors, always with high peak-to-Compton ratios and occasionally with active Compton suppression. The reduction of the gamma-ray spectral data to accurate reaction rates as performed in three independent laboratories is categorized to illustrate the areas of potential pitfalls and the diversity of approaches used in successfully avoiding them. The estimated absolute errors and the range of results among the laboratories were reduced below the target value of ±10% (2σ) for nonfission foils and is approaching the target value of ±5% (2σ) for fission foils. (auth)

24343 MEASUREMENT OF FISSION PRODUCT YIELDS AND THE ENERGY INTEGRAL FISSION CROSS SECTION OF ^{232}Th IN A ^{252}Cf FISSION-NEUTRON SPECTRUM. Deen, J. R.; Draper, E. L. Jr. (Univ. of Texas, Austin). Nucl. Technol.; 25: No. 2, 416-422(Feb 1975).

The absolute cumulative fission yield of ^{140}Ba and the relative yields of ^{131}I, ^{132}Te, and ^{141}Ce were measured for ^{232}Th irradiated in a ^{252}Cf fission spectrum of neutrons. The irradiation was performed by using two ^{232}Th foils in contact with a nominal 1-mg ^{252}Cf source in a large evacuated area for 41 days. The absolute yield of ^{140}Ba was deduced from an absolute measurement of its daughter product ^{140}La by using a calibrated NaI(Tl) detector. The activities of ^{131}I, ^{132}Te, and ^{141}Ce were measured relative to the 1596-keV gamma ray of ^{140}La by using a 43-cm^3Ge(Li) detector. The fission rate for the yield measurement and the integral fission cross section were measured by using mica solid-state track recorders. (6 tables) (auth)

24344 CHARGE DISTRIBUTION IN SPONTANEOUS TERNARY FISSION OF ^{252}Cf. Bolig, C. A. Jr. Tempe, AZ; Arizona State Univ. (1974). 121p. University Microfilms Order No. 75-1663. Thesis (Ph. D.).

The energy spectra of the light charged particles (LCP), helium (Z = 2) and hydrogen (Z = 1), resulting from the spontaneous ternary fission of ^{252}Cf were reported using a $\Delta E \times (E + \Delta E)$ particle telescope identifying apparatus. A coincidence circuit was then constructed so that the K x rays from the light ternary fission fragment were electronically gated by a designated LCP and then stored in the multichannel analyzer. Advancements in solid state technology have resulted in the design of a high-resolution lithium-drifted silicon spectrometer which makes it possible, by applying a K x-ray analysis, to identify accurately the elements in the charge distribution. Positive correlations with the nuclear liquid-drop model and the nuclear shell-model were observed. The odd–even pairing energy effect was noticeable in the charge distributions with the odd-Z elements showing the greater instability. The magic numbers 50 and 82, from shell-model theory, influenced the K x rays by shifting them from the doubly-magic number region (Z = 50 and N = 82) to the singly-magic number region (N = 50). There was a greater abundance of K x rays in the region Z = 39 to Z = 43 when the LCP was a helium particle. This increase could be a liquid-drop model influence in that a helium LCP would certainly cause a greater surface energy deformation than would a hydrogen LCP. This excess deformation would then cause an increase in de-excitation gamma radiation, which would then result in a larger probability of K x-ray production. (Diss. Abstr. Int., B)

24345 FORMATION OF K VACANCIES FOLLOWING A LOW ENERGY BETA DECAY: $^{203}Hg \rightarrow {}^{203*}Tl$ (279 keV). Thibaud, J. P.; Briancon, C.; Walen, R. J. (CRNS, Orsay, France). J. Phys. (Paris), Lett.; 35: No. 7, L89-L90(Jul 1974). (In French).

The internal K ionization accompanying the β decay of mercury 203 feeding the 279 keV level in thallium 203 was measured by means of X_{K_γ} coincidences. The experimental result $P_K = (1.5 \pm 0.45)10^{-3}$ agrees with the theory of Law and Campbell. (auth)

24346 ENERGY DEPENDENCE OF AVERAGE NUMBER OF PROMPT NEUTRONS IN ^{241}Pu FISSION. D'yachenko, N. P.; Kolosov, N. P.; Kuz'minov, B. D.; Sergachev, A. I.; Surin, V. M. Sov. At. Energy (Engl. Transl.); 36: No. 4, 406-407 (Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 321-322(Apr 1974).

The energy dependence of ν for ^{241}Pu was determined on the basis of fission energy balance by utilizing experimental measurements of fission-fragment mass and kinetic energy distributions. Such distributions of the fragments from ^{241}Pu fission by monoenergetic neutrons were measured in the energy range from 0 to 2.8 MeV in steps of 150 to 200 keV and for E_n = 5 MeV. (1 figure, 1 table) (RWR)

24347 HALF-LIFE OF ^{241}Am. Polyukhov, V. G.; Timofeev, G. A.; Privalova, P. A.; Baklanova, P. F. Sov. At. Energy (Engl. Transl.); 36: No. 4, 402-403(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 319-320(Apr 1974).

The half-life of ^{241}Am was determined by $4\pi\alpha$ measurements of the aliquot of a solution having a known ^{241}Am concentration. The details of painstaking purification procedures are set forth. No significant differences were found in eight series of measurements. A value of 432.8 ± 3.1 y was obtained. (1 table) (RWR)

24348 PROTON INDUCED FISSION OF ^{232}Th AND ^{238}U. Eaker, R. W. Tallahassee; Florida State Univ. (1974). 146p. University Microfilms Order No. 75-4760.

Thesis (Ph. D.).

A study of the mass and charge distributions of ^{232}Th and ^{238}U proton-induced fission was performed at a proton bombarding energy of 15.5 MeV. Cumulative and independent yields were measured for various fission product nuclides by using Ge(Li) spectroscopy. The Minimum Potential Energy (MPE), Equal Charge Displacement (ECD), and Unchanged Charge Distribution postulates were tested with various mass equations and a neutron function derived from experimental data. The MPE postulate, with a shell-effected mass equation, was found to fit the 15.5-MeV proton fission of ^{238}U best. For the 15.6-MeV proton fission of ^{232}Th, it was not possible to make a definitive choice between the MPE postulate, with a shell-effected mass equation, and the ECD postulate with a nonshell-effected mass equation. The data from both systems could be fitted on a single Gaussian dispersion curve using the MPE postulate and a shell-effected mass equation. Fragment spectra from the fission of ^{232}Th and ^{238}U induced by 10.0- to 18.0-MeV protons were measured by displaying the coincident signals from a thin-film organic scintillator detector (TFD) and a surface barrier solid-state detector (SSD) as two dimensional contour plots. Spontaneous fission fragment spectra from ^{252}Cf were measured for comparison. The response of the detection system to various parameters in the fission process was observed to be consistent with previously reported data. Symmetric-to-asymmetric and peak-to-valley ratios were determined as a function of bombarding energy. Distinct breaks in the ratio curves were mapped out in detail and were found to coincide with various reaction thresholds. (Diss. Abstr. Int., B)

24349 STUDY OF ^{249}Bk, ^{241}Am, AND ^{231}Pa WITH PROTON TRANSFER REACTIONS. Erskine, J.R. (University of Minnesota, Minneapolis, Minnesota 55455 and Argonne National Laboratory, Argonne, Illinois 60439); Kyle, G.; Chasman, R.R.; Friedman, A.M. Phys. Rev. C 11: No. 2, 561-579 (Feb 1975).

Proton single-particle states have been studied in the isotopes ^{249}Bk, ^{241}Am, and ^{231}Pa. The reaction (α, t) was utilized in the three studies. Additionally, the reaction (^{3}He, d) was used in the study of levels in ^{249}Bk. Many new levels were observed, and some could be interpreted in terms of single-particle orbitals. Also, several assignments previously made on the basis of radioactive decay studies were confirmed by the orbital signatures seen in the proton transfer spectra. Single-particle energies are extracted from the experimental data. Deformations of the nuclear central potential are deduced for ^{249}Bk and ^{241}Am. By use of the parameters of the central field for ^{249}Bk, the $f_{7/2}-f_{5/2}$ splitting is deduced for mass 250 at zero deformation and estimated for mass 300. (auth)

24350 SCISSION-POINT PARAMETERS DETERMINED BY LIGHT PARTICLE EMISSION IN FISSION OF ^{252}Cf. Gavron, A. (Los Alamos Scientific Laboratory, University of California, Los Alamos New Mexico 87544). Phys. Rev. C 11: No. 2, 580-586 (Feb 1975).

Trajectory calculations were performed in order to determine "scission-point" parameters which fit experimental data on light particle emission from ^{252}Cf. The uncertainty principle was invoked when determining the initial light particle momentum and position. Experimental ^{5}He data were fitted in order to provide an absolute time scale for particle emission. The results indicate that different light particles are fitted with different sets of parameters. None of these sets are consistent with the kinetic energy distribution in binary fission. (auth)

24351 LIFETIMES OF THE $\frac{1}{2}$ + [631] → $\frac{5}{2}$ + [622] E2 TRANSITIONS IN SOME ACTINIDE NUCLEI. Yates, S. W.; Ahmad, I.; Friedman, A. M.; Lynch, F. J.; Holland, R. E. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev., C; 11: No. 2, 599-606(Feb 1975).

Lifetimes of the E2 transitions from the $\frac{1}{2}$ + [631] state to the $\frac{5}{2}$ + [622] state have been measured in several actinide nuclei using pulsed beam and delayed coincidence techniques. The $\frac{1}{2}$ + [631] level was excited in ^{239}U and ^{243}Pu by the (d,p) reaction and in ^{241}Pu by the (d,t) reaction, and the subsequent γ-ray decay to the $\frac{5}{2}$ + [622] level was observed between beam pulses. The corresponding E2 transitions were observed in ^{243}Cm and ^{245}Cm from the radioactive decay of ^{243}Bk and ^{245}Bk, respectively, and the lifetimes were determined from electron-photon delayed coincidence experiments. The half-lives from these measurements are as follows: ^{239}U (0.78 ± 0.04 μs); ^{241}Pu (0.88 ± 0.05 μs); ^{243}Pu (0.33 ± 0.03 μs); ^{243}Cm (1.08 ± 0.03 μs); and ^{245}Cm (0.29 ± 0.02 μs). Comparisons are made between the experimental transition probabilities and theoretical estimates. The differences between the transition rates in these nuclei are understood when pairing interactions are taken into account. (auth)

24352 NUCLEAR LEVELS OF ^{239}Np EXCITED BY THE (^{3}He, d) AND (α, t) REACTIONS. von Egidy, T.; (Technische Universität München, P. Germany); Elze, Th.W.; Huizenga, J.R. Phys. Rev. C 11: No. 2, 529-540 (Feb 1975).

The single-proton-transfer reactions ^{238}U(^{3}He, d)^{239}Np and ^{238}U(α, t)^{239}Np have been measured with 28.5-MeV ^{3}He and α particles, respectively. The experimental cross sections are compared with theoretical cross sections in order to determine l values and to construct a level scheme of ^{239}Np. The configurations $(5/2)^+[642\uparrow]$, $5/2^-[523\downarrow]$, $1/2^-[530]$, and $3/2^-[521\uparrow]$ are identified. Levels of the four additional rotational bands $1/2^+[400]$, $3/2^+[651\uparrow]$, $7/2^+[633\uparrow]$, and $7/2^-[514\downarrow]$ are assigned tentatively. A level scheme of ^{239}Np containing γ rays following the β decay of ^{239}U is presented also. (auth)

Nuclear Theory

Refer also to abstracts 23883, 24075, 24085, 24089, 24095, 24117, and 24174.

24353 (CONF-730580-, pp 211-213) SOME ASPECTS OF PION ABSORPTION IN NUCLEI. Cernigoi, C. (Univ., Trieste, Italy). 15 Oct 1973.

From 3rd experimental triangle seminar on high energy nuclear physics; Trieste, Italy (28 May 1973).

In proceedings of the triangle seminar.

The various aspects of pion absorption in nuclei covered include the use of pions as probe particles to investigate the nuclear properties, the kinetics of the absorption process, and the implications of copious emission of energetic deuterons and tritons correlated with nucleons. (JFP)

24354 (CONF-7309130-(Absts.)) CONFERENCE ON NUCLEAR STRUCTURE: HEAVY IONS AND RELATED TOPICS, UNIVERSITY OF MANCHESTER, 5-7 SEPTEMBER 1973. (Institute of Physics, London (UK)). 1973. 57p.

Outlines of papers presented at the conference and given to those attending are included in this volume. Primary topics of the conference were heavy-ion transfer reactions, studies of gamma rays from heavy-ion-induced reactions, theoretical treatment of heavy-ion transfer reactions, reactions induced by light ions, and elastic and inelastic scattering of heavy ions. The following subjects were also discussed: nuclear structure from heavy-ion reactions, effective E2 charges, plasma sources for heavy ion production, perturbed angular correlations, theoretical aspects of stripping to unbound levels, heavy ions and fission, and theoretical developments in the study of heavy nuclei. (RWR)

24355 (COO-3071-109) INCLUSION OF PAULI PRINCIPLE CONSTRAINTS IN EQUATIONS OF MOTION METHODS FOR THE NUCLEAR MANY-BODY PROBLEM. Chattopadhyay, P. K.; Klein, A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 20 Aug 1974. Dep. NTIS $4.00.

The effort to isolate and study the dominant collective modes of a nuclear many-body system by generalized equations-of-motion methods (algebraic methods) confronts the inherent difficulty that such modes are correlated with each other and with noncollective modes by kinematic constraints traceable to the Pauli principle. This problem has previously been solved for simplified nuclear models. A solution is proposed for the general shell model problem of a number of interacting levels. (auth)

24356 (JINR-P4-7262) PAIR CORRELATIONS AND COLLECTIVE O^+ STATES OF NUCLEI WITH A APPROX. 56. Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). INIS.

A study is carried out on the properties of collective, "pair" O^+-states in nuclei with A ~56. It is proved that for a correct description of such states it is necessary to take into account not only paired forces, but also the single-particle symmetry potential and alpha-particle correlations. 14 refs. (tr-SJR).

24357 (ORNL-TM-4667) RELATIVISTIC ANGULAR MOMENTUM RELATIONSHIPS FOR HIGH-ENERGY HEAVY-ION REACTIONS. Bertini, H. W.; Larson, N. M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 25p. Dep. NTIS $4.25.

Established properties of the relativistic intrinsic and orbital angular momentum tensors are reviewed, and relationships be-

tween the components of these tensors are derived. These relationships reduce the number of unknowns that must be determined for the calculation of the relativistic spin of the heavy fragments in high-energy heavy-ion interactions, in the limit where quantum mechanics may be ignored. An example using the intranuclear-cascade model is presented. (1 figure) (auth)

24358 RENORMALIZATION OF THE AXIAL CURRENT FORM FACTORS IN NUCLEI. Ohta, K.; Wakamatsu, M. (Tokyo Univ. (Japan). Dept. of Physics). Nucl. Phys., A; 234: No. 2, 445-457 (2 Dec 1974).

It is shown that the weak production of a pion and its subsequent scattering off nucleons leads to effective nuclear renormalizations of the axial current form factors. It is found with Ericson, Figureau and Thevenet and Rho that the axial-vector form factor g_A is modified in the same proportion as the pion–nucleus optical potential. The renormalization of the induced pseudoscalar form factor h_A is also described. The influence of short-range nuclear correlations and off-shell pion–nucleon scattering is investigated, and the renormalized form factors in infinite nuclear matter are estimated. (auth)

24359 "MIA", A FORTRAN-IV PROGRAM FOR MAKING SPIN AND PARITY ASSIGNMENTS TO HIGH-LYING SINGLE AND COHERENT TWIN NUCLEAR LEVELS FROM (ALPHA, NUCLEON) ANGULAR DISTRIBUTIONS IN ON-RESONANCE, COMPOUND-NUCLEAR, CHANNEL-SPIN-$\frac{1}{2}$ REACTIONS. Sheldon, E.; Donati, D. R. (Lowell Technological Inst., Mass. (USA)); Hiddleston, H. R. (Notre Dame Univ., Ind. (USA). Dept. of Physics). Comput. Phys. Commun.; 8: No. 3, 199-219(Oct 1974).

Nuclear spectroscopy yielding spin and parity assignments to high lying compound nuclear levels is facilitated by the study of angular distributions from on-resonance reactions involving channel-spin-$\frac{1}{2}$ (or spin-0) incoming and outgoing interaction channels. For pure single-level or coherent twin-level resonances the spin–parity assignments can be deduced from a direct graphic comparison of measured and calculated angular distributions for, e.g., (alpha, nucleon) reactions on spin-$\frac{1}{2}$ target nuclei leading to spin-0 residual nuclear states. The program "MIA" is designed to accomplish this task, taking into account entrance and exit barrier penetrabilities, the effect of competing outgoing reaction channels and, if desired, spin–orbit coupling; it features oscilloscope display, external parameter manipulation and plotted print-out facilities that permit interactive communication between the operator and the data. (auth)

24360 NOTE ON THE USE OF HARD-CORE POTENTIALS IN TRANSFER REACTIONS. Dobes, J. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Nucl. Phys., A; 235: No. 1, 199-204 (9 Dec 1974).

The transition amplitude for the transfer reaction (d,p) is derived by assuming a hard-core interaction between nucleons. An additional term in the standard expression for the transition amplitude appears. This additional term is estimated in DWBA, and it is proved to be quite important. Previous calculations of direct transfer reactions with hard-core potentials are discussed. (auth)

24361 NUMERICAL CALCULATION OF RECOIL EFFECTS FOR SURFACE REACTIONS. Braun-Munzinger, P.; Harney, H. L.; Wenneis, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Nucl. Phys., A; 235: No. 1, 190-198(9 Dec 1974).

A recently published formalism for transfer reactions that occur on the nuclear surface and not in the interior — as seems to be the case for heavy-ion reactions —is summarized. In an economical way it allows for finite-size and recoil effects to any order. A computer code — named BRUNHILD— has been developed that uses this formalism. Numerical results are presented and compared to both experiments and the full finite-range code LOLA by De Vries that includes the nuclear interior. Good agreement is found. Various parameter dependences are discussed. (auth)

24362 ON THE POSSIBLE ROLE OF PRECOMPOUND DECAY IN HEAVY ION REACTIONS. Blann, M. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Nucl. Phys., A; 235: No. 1, 211-218(9 Dec 1974).

An exploration of the possible importance of precompound decay in heavy-ion reactions is presented in terms of the hybrid model. Beginning with an arbitrary (but hopefully reasonable) set of initial conditions, precompound spectra and excitation functions are calculated for the system $^{12}C + ^{141}Pr$. Results are compared to the experimental $^{141}Pr(^{12}C,4n)^{149}Tb$ excitation function, and it is shown that inclusion of the precompound mechanism gives a great improvement over pure equilibrium model results. It is shown that such a precompound mechanism might provide an explanation for some experimental results which are otherwise puzzling, as well as for short-comings of fusion/fission calculations via the Bohr–Wheeler formalism. (auth)

24363 THE DETERMINATION OF THE NUCLEAR GROUND STATE AND TRANSITION CHARGE DENSITY FROM MEASURED ELECTRON SCATTERING DATA. Dreher, B.; Friedrich, J.; Merle, K.; Rothhaas, H.; Luehrs, G. (Mainz Univ. (F.R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 235: No. 1, 219-248(9 Dec 1974).

The evaluation of elastic and inelastic electron scattering cross sections is discussed in terms of the Fourier–Bessel expansion of the nuclear ground state and transition charge density, respectively. The method allows one to deduce the charge distributions and the moments as well as the corresponding errors, which originate on the one hand from the uncertainties in the measured data and on the other hand from the lack of knowledge about the large-q behavior of the form factors; these two contributions are determined separately. The method is described and proved with an evaluation of pseudodata and then applied to ^{208}Pb cross sections. For this nucleus, detailed results concerning the possible structure of the charge density are presented. (auth)

24364 THE MESON PROPAGATOR IN NUCLEAR MATTER. Brusca, S. P.; Sawyer, R. F. (California Univ., Santa Barbara (USA). Dept. of Physics). Nucl. Phys., A; 235: No. 2, 470-485 (16 Dec 1974).

A formal device is presented for calculation of a meson propagator in infinite nuclear matter, through the calculation of the ground-state energy of the system in the presence of external, static meson fields, by using a pseudo-Hamiltonian simply related to the actual Hamiltonian. This approach is particularly well adapted for dealing with some effects that are not taken into account at all in multiple scattering approaches, for example, the effects of nuclear forces on the intermediate states which are involved in the meson–single-nucleon scattering. A theorem is proved about limiting conditions under which the charged pion propagator is independent of the nuclear forces. These conditions are nearly enough realized in π–nucleus scattering (sufficiently below the energy of the first resonance) so that the corrections can be evaluated perturbatively. The (virtually unknown) two-body force between the 3-3 resonance and nucleons is shown to be of considerable importance in determining the π-meson propagator. (auth)

24365 THE LOCAL FIELD CORRECTION TO THE OPTICAL POTENTIAL AT HIGH ENERGY. Keister, B. D. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). Nucl. Phys., A; 235: No. 2, 520-530(16 Dec 1974).

A key assumption in the derivation of the optical potential for high-energy hadron–nucleus scattering is that no target nucleon is struck more than once. The local field (rescattering) amplitudes gives the probability for the projectile to strike a target nucleon twice with an intermediate interaction with another nucleon. This rescattering amplitude generates a correction to the basic high-energy optical potential, and it must be small for the above assumption to be valid. The local field correction to the optical potential is evaluated using the formalism of Foldy and Walecka. The projectile–nucleon potential is assumed to have a finite range, and the target nucleons are kept sufficiently far apart by a hard-core correlation function that there is no overlap between target particles, and all off-energy-shell effects vanish. With a specific form for the high-energy behavior of the on-shell projectile–nucleon scattering amplitude, it is found that the local field correction vanishes rapidly at high energy. (auth)

24366 CONNECTED KERNEL METHODS IN NUCLEAR REACTIONS. III. Effective Interactions. Redish, E. F. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., A; 235: No. 1, 82-122(9 Dec 1974).

The recently derived connected kernel equation (CKE) for N-body scattering operators is applied to direct nuclear reactions. A spectral representation is derived for the kernel of the CKE in order to obtain manageable approximations. This allows the kernel to be split into orders corresponding to the propagation of different numbers of bound clusters. By formally solving one part of the kernel at a time, the CKE is written as a hierarchy of nested equations in increasingly many variables. The first equation of this hierarchy is a set of coupled-channel Lippmann–Schwinger equations coupling together all two-cluster channels. These equations reduce to the usual coupled-channel equations for inelastic scattering and to the coupled-channel Born approximation for rearrangement reactions when weak-coupling assumptions are made. The second equation of the hierarchy is a two-variable integral equation for the effective interactions appearing in the coupled-channel equations. The driving terms and kernel

of this integral equation are obtained from the third equation of the hierarchy, which is a three-variable integral equation, and so forth. The use of the spectral expansion results in a renormalized theory in the sense that the bound state and reaction problems are separated. This permits the inclusion of nuclear models in the theory in a straightforward manner. The hierarchy is applied to a particular example, that of nucleon–nucleus scattering. For this case the hierarchy is truncated at the level allowing no more than three clusters in the continuum. By suppressing exchange and keeping only one-particle transfer and single-nucleon knockout channels, a set of equations for the optical potentials and transfer operators is obtained. These equations provide a three-body treatment of the single scattering approximation to the optical potential. Iteration of the equations yields the usual single scattering approximation in first order including three-body off-shell effects. After suppression of Fermi motion and off-shell effects, the standard impulse approximation is recovered. Modifications of the method for other cases are discussed and other possible applications suggested. (auth)

24367 CONVERGENCE OF EFFECTIVE HAMILTONIAN EXPANSION AND PARTIAL SUMMATIONS OF FOLDED DIAGRAMS. Krenciglowa, E. M.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 235: No. 1, 171-189(9 Dec 1974).

Upon starting from a time-dependent formulation of the energy-independent effective Hamiltonian, a sequence of partial summations for the folded-diagram series is defined, and a connection between the energy-independent and energy-dependent effective Hamiltonians is shown. The partial summations are shown to be convergent in the presence of intruder states which are weakly coupled to the model space. (auth)

24368 AN APPROXIMATE THREE-BODY THEORY OF DEUTERON STRIPPING. Johnson, R. C.; Tandy, P. C. (Surrey Univ., Guildford (UK). Dept. of Physics). Nucl. Phys., A; 235: No. 1, 56-74(9 Dec 1974).

A treatment of deuteron stripping is developed in which the three-body effects associated with deuteron break-up in the nuclear field are included explicitly. The essence of the method is the choice of a convenient discrete set of n–p eigenfunctions as a representation of the three-body continuum effects. This approach leads to a distorted-wave stripping matrix element similar to that of the DWBA, except that the elastic deuteron wave is replaced by a three-body wave function given as the solution of a set of coupled two-body Schrödinger equations. The adiabatic theory of Johnson and Soper appears as the solution in a suitable first approximation. This new formalism should prove useful in the evaluation of corrections to three-body models of the deuteron–nucleus system, in particular those models in which the nucleon–target interaction is represented by a complex local optical potential. (auth)

24369 FINITE RANGE PARAMETERS FOR STRIPPING REACTIONS IN THE 1s SHELL. Eiro, A. M.; Santos, F. D. (Laboratorio de Fisica, Faculdade de Ciencias, Lisboa, Portugal). Nucl. Phys., A; 234: No. 2, 301-307(2 Dec 1974).

The normalization factor D_0 and the finite range parameter β used in the DWBA analysis of one-nucleon stripping reactions induced by 1s shell projectiles were calculated; the overlap function was represented by an Eckart wave function with correct asymptotic normalization. It is found that β decreases with increasing mass of the projectile. (auth)

24370 APPLICATION OF THE ADIABATIC, TIME-DEPENDENT HARTREE-BOGOLYUBOV APPROXIMATION TO A SOLVABLE MODEL. Krieger, S. J. (Oxford Univ. (UK). Nuclear Physics Lab.); Goeke, K. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., A; 234: No. 2, 269-284(2 Dec 1974).

The adiabatic, time-dependent Hartree–Fock theory of Baranger, Veneroni and Wong is generalized in order to include pairing effects. The theory is applied to a two-level pairing model, and the results are compared with the generator-coordinate method and with the exact solution. Some tentative conclusions regarding the range of validity of the theory are made on the basis of the model results. (auth)

24371 SURFACE TRANSPARENCY AND DIFFRACTION IN HEAVY-ION INDUCED TRANSFER. Kahana, S. (Brookhaven National Lab., Upton, NY). Comments Nucl. Particle Phys.; 6: No. 1, 9-14(Feb 1974).

It is stated that since the subject of heavy ion induced transfer reactions was last discussed in these comments (Robson Comments Nucl. Part. Phys. 5:124 (1972)) a rather general picture of some simplicity and having an element of surprise has emerged. This picture is discussed. Amongst matters considered is a possible transition in few nucleon transfer angular distributions from a smooth classical to an oscillating quantum mechanical shape; also the appearance of diffractive behavior at an extremely low energy, where it was thought that the strong Coulomb field between massive projectile and heavy target would cast a "classical hue" over the transfer process. The end result of these findings should be the possibility of extracting structure information from what were formerly considered uninteresting angular distributories. 12 references. (UK)

24372 DIRECT PROBLEMS IN THE CLASSIFICATION OF THE MULTIPLICITY OF NUCLEAR PROCESSES. Galkin, V. Ya. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 216: No. 5, 1014-1017(11 Jun 1974). (In Russian).

Multiplicity of nuclear processes is examined mathematically in the case of constant intensity of the primary particle beam and is formalized by the introduction of Poisson random values and by examination of these arbitrary values. (JSR)

24373 METHOD FOR OBTAINING SYMMETRIZED REPRESENTATIONS OF SU(2) × SU(2) AND THE ROTATION GROUP SO(4). Gard, P. (Cambridge Univ., Eng.). J. Phys., A (London); 7: No. 17, 2095-2100(21 Nov 1974).

A formula is obtained by which any symmetrized power of $[j_1,j_2]$ may be expressed in terms of symmetrized powers of representations belonging to lower j values. In particular formulas are obtained for $[\frac{1}{2},J] \otimes (2)$ and $[1,J] \otimes (2)$. The method is generalized to cover groups of the form SU(2) × SU(2) × ... (r times). This problem has application to the L-S coupling shell model of nuclear physics. (auth)

24374 PARTICLE-HOLE EXCITATIONS IN OPEN-SHELL NUCLEI. Trong, C. N. Toronto; Univ. of Toronto (1972). 192p. Thesis.

The equations-of-motion approach is adopted for nuclear spectroscopic calculations. General equations of motion are derived where the assumption of a scalar ground state is no longer necessary. The equations are then used to define the open-shell random phase approximation, an extension of the traditional random phase approximation to more complex nuclei. Some formal properties of the OSRPA solutions and various expressions used to construct the eigenvalue equation and to evaluate its matrix elements are given. As an application, negative parity states of the even isotopes of nickel are calculated. Isospin is assumed to be a good quantum number. The results obtained agree well with existing experimental data. In particular, various features of the giant dipole resonances in ^{58,60}Ni can be explained in terms of an isospin structure. Large electromagnetic and isoscalar transition rates are also found for the octupole vibration. (auth)

24375 CHANNEL–CHANNEL CORRELATIONS INDUCED BY ISOBARIC ANALOG RESONANCES IN THE DECAY OF $T_<$ COMPOUND NUCLEUS LEVELS. Albrecht, R. (Max-Planck-Inst. fuer Kernphysik, Heidelberg); Mudersbach, K.; Wurm, J. P.; Zoran, V. Rev. Roum. Phys.; 19: No. 8, 823-834(1974).

In the framework of the recent emendations to the Hauser–Feshbach theory when direct reactions are present, it is shown that polarization measurements could provide a test of the channel–channel correlations induced by isobaric analog resonances in the decay of $T_<$ compound states. An order-of-magnitude calculation of the polarization due to the enhancement for the inelastically scattered protons on the $d_{\frac{5}{2}}$ IAR at 7.61 MeV in ^{90}Zr + p was made. It is inferred that, for cases in which the IAR is a strong doorway for more inelastic channels, the deviations from the statistical model could be measured. (3 figures) (auth)

24376 GENERAL FEATURES OF THE WEIGHT-FUNCTION AND AVERAGING OF THE OPERATORS ON THE BASIS OF THE INTERNAL NUCLEAR WAVE-FUNCTIONS. Kalinauskas, R. K.; Vanagas, V. V. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 3, 491-506(1974). (In Russian).

The reflection matrix in O_{n-1}-irreducible spaces labeled by the canonical basis of the O_r groups (r = n – 1, n – 2, ...) as well as the transformation matrix between the two canonical bases of the orthogonal O_{n-1} and O^+_{n-1} groups is described. It is shown that in the case of the canonical basis of the O_{n-1} group (n–the number of nucleons in the nucleus) the weight–function being used in the fractional-percentage decomposition is the product of the three matrix elements of the O_{n-1}-irreducible matrix, depending on the three one-parameter subgroups of the O_{n-1} group. The method of averaging of the one- and two- particle operators on the basis of the internal wave functions of the nuclei, introduced in the microscopic analog of the collective Bohr–Mottelson model, is given; and the significance of reflections on introducing the internal nuclear variables is explained. (auth)

24377 THERMOSTATIC PROPERTIES OF SYMMETRIC NUCLEAR MATTER. Kupper, W. A.; Wegmann, G.; Hilf, E. R. (Sektion Physik der Universitat Muenchen, 8046 Garching, Germany). Ann. Phys. (N. Y.); 88: No. 2, 454-471(Dec 1974).

The thermostatic properties of symmetric nuclear matter are calculated by extension of a recent Thomas–Fermi approach to ground-state nuclei by Myers and Swiatecki. We have computed the free energy per nucleon f(T,n) in Landau's quasiparticle approximation to finite excited nuclei, the degenerate limit of nuclear matter is discussed in particular. As an interesting result we find at higher temperatures van-der-Waals-like isotherms in the p-n plane. Below the critical temperature $T_c = 17.3$ MeV two phases of nuclear matter, liquid and vapor, are defined by these. Comparing these results with the reduced phase transition data of ^{3}He, ^{4}He, and "inert gases," we find that nuclear matter is similar to the He isotopes, but differs considerably from the inert gases. (auth)

24378 SIMPLE RELATION BETWEEN THE ASYMMETRY AND LONGITUDINAL POLARIZATION OF THE RECOIL NUCLEUS IN MUON CAPTURE. Subramanian, P.R.; Devanathan, V. (Department of Nuclear Physics, University of Madras, Madras 600 025, India). Phys. Rev. C 11: No. 2, 520-523 (Feb 1975).

An interesting relation $\alpha - 2P_L = 1$ is obtained between the asymmetry parameter α and the longitudinal polarization P_L of the recoil nucleus in the reaction $\mu^- + A\ (J_i^{\pi_i}) \rightarrow B\ (J_f^{\pi_f}) + \nu_\mu$, in which the initial nuclear spin is zero. It is shown algebraically that this relation is independent of both the nuclear structure and the values of the coupling constants of the muon capture interaction with or without inclusion of second-class current terms. (auth)

24379 CONSEQUENCES OF FISSION DEEXCITATION OF COMPOUND NUCLEI FORMED IN HEAVY–ION REACTIONS. Plasil, F. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Blann, M. Phys. Rev. C 11: No. 2, 508-519 (Feb 1975).

Restrictions on cross sections of compound nuclei surviving fission during the deexcitation process are investigated for a variety of heavy–ion projectile–target combinations. Calculations are performed within the framework of the Bohr–Wheeler model using angular–momentum–dependent fission barriers calculated from the rotating liquid drop model of Cohen, Plasil, and Swiatecki. It is shown that fission severely limits the cross sections of evaporation residue products at higher bombarding energies, that the critical angular momenta of such a model slowly increase with increasing bombarding energy, and that these critical angular momenta are very much lower than the values at which the fission barrier is thought to disappear. Calculated cross sections are in reasonable agreement with several experimental excitation functions. Experimental results are also compared with limits on fusion cross sections resulting from entrance conditions and comparisons are made between the consequences of the two types of models—entrance condition limits and fission–imposed limits on evaporation residue products. (auth)

24380 NUCLEON–NUCLEON CORRELATIONS AND THE PION–NUCLEUS INTERACTION. Celenza, L.S.; Liu, L.C.; Shakin, C.M. (Institute of Nuclear Theory and Department of Physics, Brooklyn College of the City University of New York, Brooklyn, New York 11210). Phys. Rev. C 11: No. 2, 437-449 (Feb 1975).

The scattering of pions from a correlated pair of nucleons is studied in a recently proposed covariant theory of pion–nucleus scattering. In this theory the off–shell effects arising from the correlations can be treated unambiguously. In the covariant theory, "off–shell effects" refers to *both* the usual off–shell effects known from conventional nonrelativistic multiple–scattering theories and to *off–mass–shell* features particular to the relativistic theories. It is shown that these effects, absent in a "fixed–scatterer approximation," require knowledge of the fundamental pion–nucleon scattering amplitudes in regions which are not readily parametrized using on–shell scattering data. In a simplified model we illustrate this point by comparing our dynamical approach to the corresponding fixed–scatterer analysis. We conclude that any reliable estimate of correlation effects in pion–nucleus interaction requires that serious consideration be given to the off–shell aspects of the dynamics. (auth)

24381 WHY THE HAUSER–FESHBACH FORMULA WORKS. Moldauer, P.A. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. C 11: No. 2, 426-436 (Feb 1975).

It is shown that flux conservation requires substantial channel–channel correlations of resonance amplitudes. These, together with the effects of level–level correlations and other terms, conspire to cancel the large additive corrections to the Hauser–Feshbach formula for the fluctuation cross section. The remaining multiplicative corrections become negligible for nonelastic cross sections when many channels are open. In other cases, approximation formulas provide estimates that are adequate for most purposes. However, the Bohr independence hypothesis is not always satisfied when fewer than about 20 channels are open. The cross section correlation width is shown to differ markedly from the average width. The use of the former for estimating the Hauser–Feshbach denominator is found to be justified. All of these results are verified by means of statistical model calculations of resonance parameters and of cross sections. (auth)

24382 REGGE–TYPE REPRESENTATIONS OF THE PARTIAL WAVE AMPLITUDES FOR SPIN–ZERO–SPIN–ONE SYSTEMS. Satpathy, R.K.; Mishra, A.P. (Department of Physics, Sambalpur University, Sambalpur, Orissa, India). Phys. Rev. C 11: No. 2, 637-638 (Feb 1975).

Regge–type representations are developed for the scattering amplitude of spin–one particles elastically scattered from nuclei. This work forms an addition to a recent paper by Shanta and Satpathy on the Regge–type representations. (auth)

24383 COMMENT ON WELL MATCHING IN DISTORTED–WAVE–BORN–APPROXIMATION PREDICTIONS FOR TWO–NUCLEON TRANSFERS. Daehnick, W.W.; DelVecchio, R.M. (Nuclear Physics Laboratory, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). Phys. Rev. C 11: No. 2, 623-624 (Feb 1975).

The sensitivity of many calculations in the distorted–wave–Born–approximation (DWBA) to optical model parameter ambiguities has led to the introduction of a well–matching condition which was discussed in a recent paper. The claim for the merit of this condition was based primarily on its success and consistent usefulness in standard DWBA calculations. A theoretical argument given for its plausibility is explained in greater detail. It is argued that the absence of restraints on optical model potentials may be expected to lead to poor results with the common DWBA approximations, whereas the well–matching condition helps to insure the smallness of some generally neglected terms. (auth)

24384 COULOMB–ENERGY ANOMALY. Jänecke, J. (Department of Physics, Cyclotron Laboratory, The University of Michigan, Ann Arbor, Michigan 48105). Phys. Rev. C 11: No. 2, 625-627 (Feb 1975).

The droplet model mass equation of Myers and Swiatecki contains isospin–nonconserving contributions. When applied to the displacement energies between isobaric analog states, one obtains a hydrodynamical description of the Auerbach–Kahana–Weneser core polarization effect. The effect is not sufficient to explain the Coulomb–energy anomaly (Nolen–Schiffer anomaly) in light nuclei but is likely to contribute to the observed anomaly in heavy nuclei. (auth)

24385 COMMENT ON A SYSTEMATIC DISTORTED–WAVE BORN–APPROXIMATION PREDICTION FOR TWO–NUCLEON TRANSFER: APPLICATION TO (d, α) EXPERIMENTS. Werby, M.F. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106 and The Florida State University, Tallahassee, Florida 32306). Phys. Rev. C 11: No. 2, 621-622 (Feb 1975).

In a recent study of (d, α) reactions on medium and heavy nuclei, DelVecchio and Daehnick employ a well–matching condition which limits the choice of the optical model potentials. It is shown that, in the authors' derivation of the well–matching condition, they violate the post–prior equality necessary for distorted–wave transition amplitudes. (auth)

24386 THREE–BODY FORCE IN NUCLEAR MATTER. Blatt, D.W.E. (Department of Theoretical Physics, University of Sydney, Sydney, New South Wales, Australia 2006); McKellar, B.H.J. Phys. Rev. C 11: No. 2, 614-620 (Feb 1975).

We report calculations on the contribution of the three–body potential W to the energy of nuclear matter which include realistic correlations in all internucleon distances which are consistent with realistic two–body potentials (V) in the calculation of the dominant second-order $[\langle V\ (Q/e)\ W \rangle]$ contribution to the binding energy. For the Reid soft-core potential we get a binding energy contribution of 6 MeV/nucleon. This is to be compared with the binding energy of 1.7 MeV/nucleon obtained using hard-core potentials. The latter result is consistent with the calculations of Loiseau, Nogami, and Ross. The physical reason for the large difference between the results obtained from hard-core and soft-core two–body potentials is clarified. (auth)

24387 INCLUSION OF PAULI PRINCIPLE CONSTRAINTS IN EQUATIONS–OF–MOTION METHODS FOR THE NUCLEAR MANY–BODY PROBLEM. Chattopadhyay, P.K.; Klein, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174). Phys. Rev. C 11: No. 2, 610-613 (Feb 1975).

The effort to isolate and study the dominant collective modes of a nuclear many–body system by generalized equations–of–motion methods (algebraic methods) confronts the inherent difficulty that such modes are correlated with each other and with noncollective modes by kinematic constraints traceable to the Pauli principle. This problem has previously been solved for simplified nuclear models. A solution is proposed for the general shell model problem of a number of interacting levels. (auth)

24388 PERTURBATION CALCULATIONS FOR A MODEL NEUTRON LIQUID. Shen, L. (Department of Physics, California State University at Fullerton, Fullerton, California 92634); Sim, H.; Woo, C. Phys. Rev. D 10: No. 12, 3925-3930 (15 Dec 1974).

Perturbation corrections to energies obtained by variational methods are computed for the "homework" neutron liquid. First, the Jastrow wave function is optimized by means of the paired–phonon analysis.

Next, effects of three–particle correlations are estimated through a second–order perturbation calculation. Both corrections are small, amounting to about 5% and 1%, respectively. (auth)

24389 DESCRIPTION OF NUCLEAR RESONANCES WITH MIXED ISOSPIN. Shanley, P.E. (Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556). Phys. Rev. Lett. 34: No. 4, 218-221 (27 Jan 1975).

It is pointed out that a formulation commonly used to describe mixed–isospin nuclear resonance is incorrect. An alternative approach is suggested and applied to some examples. (auth)

24390 SEMICLASSICAL APPROXIMATION IN A ONE–BODY POTENTIAL. Jennings, B.K.; Bhaduri, R.K. (Niels Bohr Institute, Copenhagen, Denmark); Brack, M. Phys. Rev. Lett. 34: No. 4, 228-230 (27 Jan 1975).

For a system of noninteracting fermions in a local potential with no discontinuous edges, an explicit series in the expansion parameter $\hbar^2$ is derived for the "smooth" part of the energy. The method is based on the semiclassical partition function developed by Wigner and Kirkwood. Numerical calculations are done for spherical and deformed Woods–Saxon potentials. Comparisons are made with other methods, and in particular the numerical accuracy of the Strutinsky smoothing is tested. (auth)

24391 BACKGROUND PHASE SHIFT IN *R*–MATRIX THEORY. Cugnon, J. (Physics Department, University of Liège at Sart Tilman, B–4000 Liège I, Belgium). Phys. Rev. C 11: No. 2, 291-301 (Feb 1975).

R–matrix theory and other theories involving a division of the configuration space into an internal and an external region are derived in the frame of a projection operator formalism. The continuity condition is particularly investigated. In connection with this problem, we show that the introduction of the hard-sphere phase shift is quite arbitrary and that it can be replaced by any other phase shift. (auth)

24392 BOUND STATE REPRESENTATION OF SCATTERING SOLUTIONS. Bassichis, W.H.; Reading, J.F.; Scheerbaum, R.R. (Department of Physics and Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. C 11: No. 2, 316-322 (Feb 1975).

Approximate positive energy continuum eigenstates of a one–body Hamiltonian, already projected onto a finite dimensional harmonic oscillator basis, are constructed from the set of discrete–energy states obtained by diagonalizing the Hamiltonian. The method should be especially useful for calculating the virtual, continuum, intermediate states in many–particle calculations. The results for the test cases considered, the square well and the nonlocal Hartree–Fock potentials, are quite accurate both in the wave functions and the phase shifts. (auth)

24393 NUCLEUS–NUCLEUS CROSS SECTIONS AND THE VALIDITY OF THE FACTORIZATION HYPOTHESIS AT INTERMEDIATE AND HIGH ENERGIES. Barshay, S. (State University of New York at Stony Brook, Stony Brook, New York 11790); Dover, C.B.; Vary, J.P. Phys. Rev. C 11: No. 2, 360-369 (Feb 1975).

We use an impact parameter representation of the scattering amplitude to predict nucleus–nucleus and nucleon–nucleus total, reaction, and elastic cross sections at intermediate and high energies. We investigate the question of factorization for these quantities, and find that factorization holds to 20% if the radii of the projectile and target nuclei do not differ by more than 50%. This fact and the gross violation of factorization when the nuclei are very different in size are interpreted in the context of a simple geometric model. The dependence of composite particle cross sections and factorization ratios on the size of the elementary nucleon–nucleon cross section σ_{NN}^{T} is investigated. It is shown that strict functional factorization for total and reaction cross sections in the impact parameter scheme only applies in the limit of a "weak" σ_{NN}^{T}, for which a single-scattering approximation is valid. This situation is not realized in practice, and nucleus—nucleus cross sections are instead found to be close to a geometric limit for all but the lightest nuclei. The energy dependence of nucleus—nucleus cross sections is found to be negligible above 100 MeV/particle. (auth)

24394 COLLECTIVE QUANTUM HAMILTONIAN IN THE MODEL WITH VARIABLE MOMENT OF INERTIA. Khodel', V.A. (I. V. Kurchatov Institute of Atomic Energy). JETP Lett. 20: No. 6, 188-190 (20 Sept 1974).

A procedure is proposed for finding the parameters of the collective Hamiltonian. The methods developed are applied to an analysis of the model with variable moment of inertia, which describes with sufficient accuracy the properties of the fundamental excitation band of atomic nuclei in the transition region. (auth)

24395 IS NUCLEAR MATTER VISCOUS. Recherche (Paris); 5: No. 47, 668-671(Jul 1974). (In French).

Nuclear viscosity was shown by the use of heavy ions as projectiles for the study of nuclear matter. The partial fusion caused by tangential collisions takes place with a large exchange of kinetic energy and nuclear matter, as though a neck of nuclear matter were formed in the same way as between two drops of oil, by viscosity. A second type of phenomenon connected with nuclear viscosity was also observed: when a fusion center is created it shows a strong tendency to fission. Finally the appearance of functional and viscosity forces during the approach of nuclei prevents fusion in the case of certain heavy projectiles such as krypton. (FR)

24396 SHELL MODEL FORM FACTORS WITH DENSITY DEPENDENT INTERACTION. Ismail, M.; Shabshiry, M. (Cairo Univ. (Egypt). Dept. of Physics). Atomkernenergie; 24: No. 2, 133-134(1974).

A density-dependent interaction derived from Reid's soft-core potential in the local density approximation is used to examine the shell model form factors for the inelastic scattering of a nucleon by a target nucleus. The results were compared with those for the ordinary attractive Gaussian potential and the Brink and Boeker effective interaction. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 22122, 22740, 22741, 22926, 22955, 22969, 22970, 22975–22977, 22993–22995, 23052, 23055, and 24339.

24397 (AD-784956) MODELS OF PHOTON RADIATION IN AIR. Final Report, 10 April 1970–31 March 1974. Woolson, W. A.; Huszar, L.; Harris, R. J. Jr. (Science Applications, Inc., La Jolla, Calif. (USA)). Sep 1974. Contract DASA01-70-C-0090. 63p. (SAI-73-629-LJ). NTIS $3.75.

A data base of photon transport in air for energies extending from 10 keV to 10 MeV was generated for parametric modeling for the ATR code. The data base was generated in two separate units; one for gamma-ray problems which has 18 energy groups from 0.02 MeV to 10 MeV, and the other, for x-ray problems which has 18 energy groups from 10 keV to 300 keV. The gamma-ray energy group structure is identical to the group structure for the secondary photons of the neutron ATR data base; thus allowing one to use ATR to obtain results for a complete neutron and gamma-ray radiation source problem. The x-ray data base was geared toward the special problems of obtaining accurate transport calculations for sources in the x-ray energy region. (auth)

24398 (AD-785006) MODIFICATION OF EDEP1 CODE TO ALLOW USE OF ARBITRARY ELECTRONIC ENERGY LOSS. Final Report. Hubler, G. K. (Naval Research Lab., Washington, D. C. (USA)). Aug 1974. 7p. (NRL-MR-2862). NTIS $3.00.

A computer program which calculates the distribution of energy deposited in elastic collisions for a beam of ions coming to rest in an amorphous material has recently been developed. The program, EDEP1, is useful for calculating the damage profile created in the target by the ion beam and for absolute estimates of the defect density. Simple modifications to program EDEP1 are given to enable the user to insert arbitrary electronic stopping powers into the program and eliminate the LSS calculation of electronic stopping power. (GRA)

24399 (AED-CONF-74-509-007) SIMULATION OF THE LOCAL AND TIME DEPENDENT RADIATION REACTIONS FOR NEUTRON IRRADIATION. Hehn, G.; Pfister, G.; Prillinger, G.; Stiller, P. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). 1974. 15p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

Since the RBE of neutrons depends strongly on the neutron energy, the energy spectrum must be taken into account in addition to the absorbed dose of neutrons. On the basis of real spectra of neutrons from 14-MeV and cyclotron therapy units, the local dependence of these spectra is shown in a homogeneous standard man phantom. The radiation reactions in living tissue can be determined by means of the energy-dependent RBE values. The results show that the depth dependence of the radiation reaction curve is better than the depth dose curve, but the beam profile is broadened to some extent. For detailed treatment of these effects the energy distribution of primary recoils, their equilibrium spectrum and their energy dose as a function of LET have been evaluated. For simulating the time-dependent effects the cybernetic model of Pohlit is used. (GE)

24400 (CEA-N-1726) MERCURE-4: THREE DIMENSIONAL MONTE CARLO PROGRAM FOR THE INTEGRATION OF LINE OF SIGHT POINT ATTENUATION KERNELS. Devillers, C.; Dupont, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). Jul 1974. 39p. (In French). Dep. NTIS (US Sales Only) $5.00.

The program MERCURE-4 integrates neutron or gamma-ray line of sight point attenuation kernels (biological doses, gamma heating, ...) by a Monte-Carlo technique in three-dimensional geometrical configurations and in the multigroup approximation. The program calculates and adjusts importance values which it uses for sampling source particles so that the effort of the user not familiar with Monte-Carlo is reduced to a minimum. MERCURE-4 is written in FORTRAN IV, it requires a 300 K octets storage and up to two magnetic tapes. (auth)

24401 (IAE-2249) THEORY OF CHANNELING EFFECT. II. Influence of Inelastic Collisions. Kagan, Yu.; Kononets, Yu. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 32p. (In Russian). INIS.

The density matrix formalism is used to obtain a kinetic equation which simultaneously takes into account the coherent character of diffraction in a regular medium and the inelastic processes accompanying the motion of a fast charged particle in a crystal. An analysis is made of the problem of attenuation length L_2 of the nondiagonal elements of the density matrix which are responsible for coherent effects of the type where the yield of a nuclear reaction is a function of crystal thickness. It was found that L_2 may be a number of thousands of angstroms. It is shown that at $L > L_2$ attenuation of the nondiagonal elements leads to symmetrization of the angular distribution of particles in a planar channel. A theory is developed of multiple scattering of fast charged particles under conditions of channeling. This problem reduces to the problem of two-dimensional diffusion in a space of radial momenta with a diffusion coefficient D which changes substantially on going from the channel region to a region outside the channel. It is shown that inside the channel D is determined mainly by scattering on electrons, primarily on valence electrons, and is small in comparison with its value outside the channel. From the problem solution which is obtained for the case of planar channeling it is possible to explain the abrupt anisotropy in particle angular distribution at the exit from the single crystal. In particular, it is possible to explain the effect of spreading in angular distribution along the family of crystallographic planes and simultaneously the effect of channel "screening" and also to explain features in the angular distribution for incident angles greater than the channeling angle θ_0, as well as the effect of "forcing" a channel at small thicknesses and the effect of "capture and retention of particles in a channel" at large crystal thicknesses. (7 figures) (tr-auth)

24402 (IAE-2308) CALCULATION OF ALBEDO MATRICE FOR MULTIZONE CYLINDRICAL BLOCK. Nosov, V. I.; Kompaniets, C. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 16p. (In Russian). INIS.

Within the framework of the first collision probability method the albedo characteristics of multilayer cylindrical blocks consisting of a random number of non-multiplying zones were examined. A method was proposed for the calculation of the albedo matrix β of such a block in the two-group approximation. The albedo matrix of this type can often be used in neutron physics, particularly in reactor theory for arranging effective boundary conditions. (tr-auth)

24403 (IFVE-ORZ-74-4) PHANTOM TISSUE DOSE DISTRIBUTION FROM 40 GeV/c-BEAM. Potemkin, E. L.; Frolov, V. V.; Golovachik, V. T.; Antipov, A. V.; Britvich, G. I.; Lebedev, V. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 10p. (In Russian). INIS.

The results of the measurement of the absorbed dose in phantoms irradiated with a beam of 40-GeV/c π^- mesons were reported. The measurements were made with tissue-equivalent ionization chambers with a volume of 10 cm^3. The dose on the surface of the phantom was $(4.6 \pm 0.7) \times 10^{-8}$ rad/particle/cm^2 and the maximum absorbed dose was $(9.7 \pm 1.5) \times 10^{-8}$ rad/particle/cm^2. The absorbed dose was calculated for conditions close to the experimental conditions. The calculated and experimental values agree within the limits of error. (tr-auth)

24404 (INIS-mf-1383, pp 41-46) GENERALIZED EFFECTIVE SYNTHESIS METHOD OF NEUTRON FIELD CALCULATION IN MEDIA WITH CROSS-SECTION RESONANCE STRUCTURE. Slesarev, I. S.; Sirotkin, A. M. 1973. (In Russian).

An iteration algorithm for the calculation of the neutron field in a system with resonance cross section structure was described. It uses the variational method for the synthesis of the spatial-energy distribution of neutrons. (tr-INIS)

24405 (INIS-mf-1383, pp 90-92) DETECTOR COMPOSITION EFFECT ON THE MEASURED VALUE OF THE EFFECTIVE RESONANCE INTEGRAL. Bortsov, V. G.; Naumov, V. I. 1973. (In Russian).

An approximation method was described for the calculation of the effect of perturbation of the neutron spectra by foils from the difference of its properties from the medium studied. The problem was solved in the one-dimensional approximation for cases of a foil surrounded by an infinite resonance absorber. Corrections on the effect of differences in the composition of blocks and experimental foils were obtained in the integral form. (tr-INIS)

24406 (INT-40/J) METHOD OF CORRECTIONS EVALUATION FOR THE GAMMA-RAY SELFABSORPTION IN SPATIAL

SOURCES. Krzuk, J. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1973. 13p. (In Polish). INIS.

A method for corrections calculation for the gamma-ray selfabsorption in spatial sources is described, which is valid for any shape of gamma quantum detector as well as the source itself. (auth)

24407 (LA-5704-MS) YOKIFER: A TWO-DIMENSIONAL HYDRODYNAMICS AND RADIATION TRANSPORT PROGRAM. Anderson, R. C.; Sandford, M. T. II. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 207p. Dep. NTIS $7.60.

The YOKIFER program has been written to calculate the coupled hydrodynamics and radiation transport problem in two-dimensional (R-Z) cylindrical geometry. The hydrodynamics are computed by the ICED-ALE method, the radiation transport by either the Monte Carlo or S_n method. This report is a description of the program and a guide to its use. (auth)

24408 (NRPB-R-27) FACTORS FOR DERIVING ABSORBED DOSE-RATES IN AIR DUE TO BETA PARTICLES FROM MEASUREMENTS OF ABSORBED DOSE-RATES IN TISSUE-EQUIVALENT MATERIAL. Francis, T. M.; Pook, E. A. (National Radiological Protection Board, Harwell (UK)). Aug 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Factors for deriving the absorbed dose-rates in air due to beta particles from measurements of dose-rates in tissue-equivalent material are presented for strontium-90/yttrium-90, thallium-204 and promethium-147. The factors were obtained from measurements with the N.R.P.B. extrapolation chamber using N.P.L. secondary standard sources, the dose-rates of which are quoted in units of "milli-rads per hour in air." The circumstances in which these factors may justifiably be used are discussed and conditions are given under which the factors may be applied to sources other than the secondary standard sources. (auth)

24409 (PB-235390) AIREM PROGRAM MANUAL. A Computer Code for Calculating Doses, Population Doses, and Ground Depositions Due to Atmospheric Emissions of Radionuclides. Final Report. Martin, J. A. Jr.; Nelson, J. C. B.; Cuny, P. A. (Office of Radiation Programs, Washington, D. C. (USA). Field Operations Div.). May 1974. 134p. NTIS $4.75.

A computer code useful for the calculation of doses to the general population due to atmospheric emissions of radionuclides is presented and discussed. The code is written in Fortran 4, requires 188K storage, and runs in about 20 seconds on an IBM 370 system. A standard sector-averaged Gaussian-diffusion equation is solved repeatedly for each radionuclide, wind sector, stability class and downwind distance. Radionuclide contributions to doses to up to four critical organs are summed and printed by sector and downwind distance. Population doses (person-REM) are also calculated. (GRA)

24410 (SLA-74-0010) ABSOLUTE CALORIMETRIC MEASUREMENTS OF ELECTRON ENERGY DEPOSITION IN SEMI-INFINITE GEOMETRY. Lockwood, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.

Absolute measurements of dose-depth profiles for electrons incident on aluminum were obtained by using a thin-foil calorimeter. Since this is a new technique, the experimental apparatus, calibration, and measurement procedures are discussed in detail. The absolute accuracy of the data obtained by this method is sufficient to allow a meaningful comparison with electron transport code predictions. The incident electron energies were 1.0, 0.5, and 0.3 MeV. At all three energies the data lie below the theory at the peak of the energy deposition profile and above it in the tail of the profile. (auth)

24411 (SLA-74-11) CALORIMETRIC MEASUREMENT OF DOSE-DEPTH PROFILES FOR INCIDENT ELECTRONS. Miller, G. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 23p. Dep. NTIS $4.25.

The use of thin foil calorimeters to measure dose-depth profiles for an incident electron beam is discussed. It is shown that this technique possesses significant advantages over ionization chamber and passive dosimeter methods. The technique involves square wave modulation of the electron beam. Several methods for extracting the information from the modulated thermocouple output signal are described. It is shown that the use of a method involving the time derivative of this signal after the switching transient has decayed minimizes problems associated with variations in the radial distribution of the energy input. (auth)

24412 (UCID-16680) MORSE-L: A SPECIAL VERSION OF THE MORSE PROGRAM DESIGNED TO SOLVE NEUTRON, GAMMA, AND COUPLED NEUTRON-GAMMA PENETRATION PROBLEMS. Wilcox, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1972. Contract W-7405-eng-48. 176p. Dep. NTIS $12.00.

MORSE-L is a computer code which uses the Monte Carlo method to transport both neutrons and gamma rays. The special features of this code make it particularly suitable in the solution of deep penetration problems (many mean-free-paths of material), problems with a large geometrical attenuation, and problems involving coupled neutron-gamma reactions. The basic MORSE program and the SAMBO output module were modified in order to make a single code which was useful for a specific class of transport problems. The ability to do criticality problems was deleted in this version. Some of the changes made from the original code are very briefly listed. The Monte Carlo process is briefly outlined as it is used in this code. The necessary items needed in order to run a problem are then described, followed by a very detailed description of the required problem input. The output is briefly explained and a sample problem provided in order to illustrate the concepts that have been presented. (MHR)

24413 THE INFLUENCE OF CHARGE FLUCTUATIONS ON THE ENERGY LOSS DISTRIBUTION OF CHARGED PARTICLES. Vollmer, O. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Nucl. Instrum. Methods; 121: No. 2, 373-377(15 Oct 1974). (In German).

The influence of charge exchange on the energy loss fluctuations of ions has been studied using experimental charge-exchange cross sections. The results indicate that the contribution of the charge exchange on the energy loss fluctuations can be a major factor for lower energies. (auth)

24414 ORNL BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN THICK SODIUM. Maerker, R. E.; Muckenthaler, F. J.; Clifford, C. E. (Oak Ridge National Lab., TN). pp 1343-1361 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The description of an experiment performed at the Tower Shielding Facility (TSF) is presented which provides verification of cross-section accuracy for use in transport calculations of deep penetration of neutrons through 15 ft of sodium. Results of calculations of the experiment are presented which were obtained by using the MORSE multigroup Monte Carlo code to calculate the transport based on an early version of the ENDF/B-III cross-section set for sodium. Comparison of the calculations with experiment indicates that the total neutron leakage above thermal energies penetrating 15 ft of sodium can be calculated to within approximately 30% and neutrons penetrating up to 10 ft of sodium to within approximately 10%. (FR)

24415 UNITS AND A NUMBER OF RELATIONS USED IN THE FIELD OF IONIZING RADIATION. Chapter I. Kimel, L. R.; Mashkovich, V. P. pp 5-12 of Zashchita ot Ioniziruyushchikh Izhuchenii. Moscow; Atomizdat (1966). (In Russian).

This section of the handbook presents the units of measurements of the following characteristics of ionizing radiation: activity, flux, intensity, adsorbed dose, exposure dose, rate of adsorbed dose and exposure dose, and the gamma-equivalent of radioactive samples. Coefficients are presented that relate the flux and dose rate for neutrons, gamma-quanta and monoenergetic electrons. This handbook can be useful to all those working with radioactive substances and sources of ionizing radiation. (tr-SJR)

24416 ELECTRON DEPTH ABSORBED DOSE DISTRIBUTION FOR A 10 MeV CLINICAL MICROTRON. Brahme, A.; Hulten, G.; Svensson, H. (Inst. of Radiation Physics, Stockholm). Phys. Med. Biol.; 20: No. 1, 39-46(Jan 1975).

Central axis depth absorbed dose distributions of the electron beam from a medical microtron accelerator have been measured. The measured distributions differed from those of existing betatrons and linear accelerators. A larger absorbed dose build-up and a sharper dose fall-off were obtained in close agreement with theoretical calculations for monoenergetic electron beams. The differences from other accelerators were explained by the narrow energy spectrum, the clean geometry and the small amount of scattering material in the electron beam of the microtron. (auth)

24417 PROBABILITY TABLE METHOD FOR HANDLING UNRESOLVED RESONANCES IN MONTE CARLO CALCULATIONS. Levitt, L. B. (North American Rockwell Corp., Canoga Park, CA). pp 1220-1231 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The representation of neutron cross section data in the unresolved resonance energy range in a way suitable for continuous energy Monte Carlo calculations is limited severely by the high-speed memory size of even the largest computers. A new approach, known as the Probability Table Method, has been developed. The basic idea of the method is to represent the neutron cross section at a given energy, not by a unique value, but by a distribution function, in tabular form, whose mean value is the infinite dilution smooth average value. Recent success in using these tables in both Monte Carlo and analytical calculation indicate that probability tables could serve as a standard way of representing neutron cross sections in the unresolved resonance energy range. (FR)

24418 DOSE DISTRIBUTIONS IN HIGH ENERGY ELECTRON BEAMS: PRODUCTION OF BROAD BEAM DISTRIBUTION FROM NARROW BEAM DATA. Lillicrap, S. C.; Wilson, P.; Boag, J. W. (Inst. of Cancer Research, Sutton, Eng.). Phys. Med. Biol.; 20: No. 1, 30-38(Jan 1975).

In a high energy electron beam the spatial distribution of absorbed energy is dominated by multiple scattering of the electrons. The dose distribution in a broad parallel electron beam entering a uniform phantom can be resolved into a series of narrow beams overlapping one another, in each of which the scattering conditions are identical. It is therefore possible to build up a broad beam dose distribution from a knowledge of the axial and radial dose distribution in a narrow beam. Measurements have been made of such narrow beam distributions using finely collimated electron beams in the energy range 4 to 10 MeV, and the resulting data added by computer to give broad beam distributions which were compared with measured isodose curves. The method has been extended also to construct isodose distributions in heterogeneous phantoms. The advantages of storing electron beam data in the form of narrow beam distributions are described with particular reference to the problem of irradiating heterogeneous tissue volumes. (auth)

24419 ANISOTROPY OF PHOTON EMISSION IN TRANSPORT CALCULATIONS. Dudziak, D. J.; Bosler, G. E. (Los Alamos Scientific Lab., NM). pp 1232-1248 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Photon production data, including angular distributions, presently exist in the ENDF for several materials. The LAPH series of codes were developed to compute Legendre moments of multigroup photon-production matrices. Initial investigations were made into the effects of photon-emission anisotropy on flux distributions. Coupled neutron–photon transport calculations were performed with the DTF-IV code. Comparisons of P_3 scattering calculations, using P_0 and P_2 photon-production matrices were made for a fission source in 5 meters each of sodium and concrete. Total fluxes between P_0 and P_2 approximations differed by up to 11% in photon groups containing anisotropically emitted photons. (FR)

24420 CONVERSION OF BETA-RAY DOSE RATES MEASURED IN AIR TO DOSE RATES IN SKIN. Pook, E. A.; Francis, T. M. (National Radiological Protection Board, Harwell, Eng.). Phys. Med. Biol.; 20: No. 1, 147-148(Jan 1975).

The critical tissue when dealing with dose to the skin is considered to be the basal cell layer of the epidermis at an assumed depth of 5 mg cm^{-2} to 10 mg cm^{-2} below the skin surface. The factors recommended by the British Committee on Radiation Units and Measurements (BCRU, 1974, Phys. Med. Biol.; 19: 748) for conversion of beta-ray dose rates measured in air to those in tissue at this depth, were derived from results obtained by Owen (1973, Phys. Med. Biol.; 18: 355) and are at variance with those derived from the authors' results. A comparison of the two sets of factors for thallium-204 and promethium-147 showed no significant differences. The difference between the factors for ^{90}Sr plus ^{90}Y was highly significant, and was probably the result of a different approach to the derivation of the backscatter factor. (UK)

24421 NEUTRON AND CAPTURE GAMMA SPECTRA IN A TISSUE-EQUIVALENT SLAB FOR ISOTROPIC IRRADIATION. Abagjan, A. A.; Dubinin, A. A.; Obaturov, G. M.; Shalin, V. A.; Zhuravlev, V. I.; Vrazhnov, Yu. N.; Kostin, E. I. (Inst. of Physics and Power Engineering, Obninsk, USSR). Health Phys.; 27: No. 5, 481-489(Nov 1974).

Calculated spectra of neutron and capture γ rays in a 30 cm thick infinite tissue-equivalent slab irradiated on one face by monoenergetic neutrons with energy in the range from thermal to 10 MeV, distributed isotropically, are presented. The ROZ-5 code was used for the calculation. The program is a complex of one-dimensional programs for solution of the transfer equation in a plane geometry. It is shown that for neutron isotropic irradiation with any spectral distribution: (1) the neutron spectrum in the slab is "softened" as depth increases to the back surface of the slab; (2) the capture γ spectrum in the slab has identical shape with the sharp distinguished peaks produced by the 2.2 and 4.5 MeV γ-rays of the $^{1}H(n,\gamma)\,^{2}H$ and $^{14}N(n,\gamma)^{15}N$ reactions. The distributions of the neutron absorbed dose and the dose equivalent were calculated in the slab using these data on the neutron spectrum in the slab. These results are in good agreement with data published by other authors. (auth)

24422 SOME OBSERVATIONS ON MPFD OF NEUTRONS. Nagarajan, P. S.; Sethulakshmi, R.; Nandakumar, A. N. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 28: No. 2, 165-168(Feb 1975).

The maximum permissible flux density (MPFD) of neutrons is a derived standard from the primary one of a maximum permissible dose equivalent (MPDE). The value of MPDE itself has varied over time from 0.25 R/day in 1928 through a number of lower figures to the presently accepted figure of 5 rem/yr. The 40-hr-week MPFD of neutrons of any energy E is obtained as 6.944×10^{-7}/DE (max), where DE (max) is the maximum of the depth-dose equivalent distribution due to neutrons of energy E in a phantom approximating the human body. The neutron flux densities corresponding to a dose equivalent rate of 2.5 mrem/hr at the position of the maximum of the depth-dose equivalent distribution obtained from the published figures of a number of workers, for energies from 0.1 eV to 10 MeV, are tabulated. From these data recommended values are given of MPFD. The special case of MPFD for personnel working near thick shields surrounding a reactor or accelerator room is considered. By assuming that any measured flux ϕ near such a shield is composed of a pair of parallel opposing neutron beams of equal fluxes $\phi/2$ it is shown that the MPFD could safely be enhanced by a factor of about 1.8. (UK)

24423 CALCULATED DEPTH DOSE TABLES FOR CALIFORNIUM-252 SEED SOURCE IN TISSUE. Krisknaswamy, V. (Albert Einstein Coll. of Medicine, Bronx, NY). Phys. Med. Biol.; 19: No. 6, 886-888(Nov 1974).

Californium-252 sources are now available in a seed form of active length 0.4 cm. The source is a Pd-252 Cf cermet core (0.2 mm diameter) surrounded by a Pt–Ir sheath approximately 0.3 mm thick. Neutron and gamma depth dose tables have been calculated for this source in tissue, thus supplementing the data given for other types of ^{252}Cf needles and tubes. (UK)

24424 RADIATION PHYSICS AND RADIATION HYGIENE IN THE USE OF DENTAL X-RAY APPARATUS. I. Radiation Physics and Radiation Biology. Johansen, J. (Statens Institutt for Straalhygiene, Oslo). Nor. Tannlaegeforen. Tid.; 83: No. 9, 383-388(Oct 1973). (In Norwegian).

The basic physics of x-radiation and x-ray tubes is explained. Scattering and absorption are discussed generally and biological radiation effects are briefly treated. Radiation doses are discussed with reference to dental radiography practice. (NO)

24425 IN SITU ANALYSIS OF SHIELDED, GAMMA-ACTIVE MATERIAL USING A Ge(Li) SPECTROMETER. Spiers, E. W.; Lakey, J. R. A. (Royal Naval Coll., Greenwich, Eng.). pp 812-827 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The full energy absorption peak efficiency of a Ge(Li) detector is experimentally determined and mathematically formulated as a function of source position and gamma-ray energy, thus allowing the calculation of detector efficiency for an extended source of known dimensions. The technique is applied to the measurement of a uniform cylindrical source inside a steel tube, such as occurs when corrosion products are deposited on the inside walls of reactor coolant pipes. Test measurements made on a simulated cylindrical source of known specific activity gave results of better than 20% accuracy. (FR)

24426 INVARIANT IMBEDDING AND RADIATION DOSIMETRY. X. Intensity of Finite Order Scattered Gamma Radiation Emergent from a Target Slab with Internal Sources. Bellman, R.; Vasudevan, R.; Ueno, S. (Univ. of California, Los Angeles). AT-(04-3)-113. Math. Biosci.; 23: No. 1/2, 1-9(Feb 1975).

In a series of papers external and internal radiation fields that have suffered a finite number of scatterings in a target slab illuminated monodirectionally from the top were computed. To study malignant growths inside, radioisotopes are deposited inside the organs and the external radiations are analyzed. To aid this procedure, the external radiation fields emanating from a target slab containing internal sources are being computed. This will be of great importance both in diagnosis and therapy. (auth)

24427 ANGULAR DEPENDENCES OF THE ION–ELECTRON EMISSION COEFFICIENT. Brusilovskii, B. A.; Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 23: No. 2, 131-134(1974).

In cases when the primary ion beam direction is aligned with close-packed planes of a single crystal of a metal target the dependence of the reduced coefficient of ion–electron emission on various angles has been studied. It was found that there are such ranges of azimuthal angle and angle of incidence of primary ion beam within which the reduced coefficient is determined mainly by the angle between the primary ion beam and close-packed plane only. (auth)

24428 ELECTRON ATTENUATION LENGTH IN NaCl. Battye, F. L.; Liesegang, J.; Leckey, R. C. G.; Jenkin, J. G. (La Trobe Univ., Bundoora, Australia). J. Phys., C (London); 7: No. 21, L390-L394(7 Nov 1974).

The electron attenuation length in NaCl has been determined to vary from 18(2) Å at 76 eV to 47(3) Å at 1403 eV by means of a photoelectron overlayer technique. The results have been analyzed in terms of three theoretical models and reasonable agreement was established. (auth)

24429 EXPERIMENTAL DATA ABOUT DECHANNELING AND CHANNEL STOPPING POWER. Schmid, K.; Fischer, G.; Mueller, H.; Ryssel, H. (Univ., Munich). Radiat. Eff.; 23: No. 3, 145-149(1974).

The dechanneling probability for a He^+ particle beam which is used for back-scattering experiments was investigated at various experimental parameters. The parameters used to get a relation between dechanneling probability and disorder density are stripping depth, annealing temperature, element and dose of the particles which caused the lattice defects by implantation. The relation between the stopping power for a He^+ particle beam incident along a random direction and incident along a ⟨100⟩ channel direction was measured on epitaxial layers of silicon on spinel and silicon on sapphire. (auth)

24430 SEVERAL RESULTS AND PROBLEMS IN THE STUDY OF MEDIUM-ENERGY ION SCATTERING BY CRYSTALLINE SOLIDS. Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 23: No. 3, 197-207(1974).

From 5th international conference on atomic collisions in solids; Gatlinburg, TN (Sep 1973).

This paper is an attempt to trace, without going into details, the inherent logic and major lines of investigations, several results and also some difficulties involved in the study of medium-energy ion scattering by crystals. By "medium energies" is usually meant an energy region in which, strictly speaking, both mechanisms of energy losses (elastic and inelastic) should be taken into account. By tradition, as the limiting energy which demarcates the intervals with different dominant mechanisms of energy losses such as energy is usually accepted, which, being expressed in keV, is equal to atomic number of an incident ion independently of the target material (the so called "simplified criterion of Seitz"). Thus, the "medium energy" region is the energy interval in the neighborhood of the above-mentioned limiting energy. In other words, this is the range in the order of a few keV to several tens of keV, depending upon the sort of ions used. (auth)

24431 COMPUTER SIMULATION OF THE PENETRATION OF HIGH ENERGY HEAVY IONS THROUGH THIN GOLD SINGLE CRYSTALS. Schmidt, H.; Ewald, H. (Giessen Univ. (F.R. Germany). 2. Physikalisches Inst.). Z. Naturforsch., a; 29: No. 10, 1442-1448(Oct 1974). (In German).

4 figs.; 16 refs. Part of a thesis by H. Schmidt.

A computer program for following the trajectories of high-energy ions in a fcc lattice has been written to study the energy loss of 60-MeV ^{127}I ions channeled between (100) and (111) planes of a Au single crystal. The motion of the ions is treated classically. It is assumed that the ion has only one important interaction at a time as it moves through the lattice. The interaction potential used in the calculation is a screened Coulomb potential with a screening function derived from Thomas–Fermi theory. The slowing down of the incident ions through inelastic encounters with the atoms of the medium is described by a stopping power function which increases exponentially with the distance from the midplane of the channel walls. (auth)

24432 EXPERIMENTAL DETERMINATION OF THE NEED FOR MULTITAPER COLLIMATORS FOR NEUTRON RADIOTHERAPY. Jones, K. M.; Kelsey, C. A. (Univ. of Wisconsin, Madison). Med. Phys.; 1: No. 4, 215-218(1974).

A 52.5-cm-long steel collimator for 15-MeV neutron therapy beams has been evaluated in terms of the distribution of the collimator-scattered neutrons in the field and penumbra, the distribution in the collimator of the neutron scattering sites, and the energy of the neutrons scattered to one position in the penumbra, in order to assess the need for multiple tapers on such collimators. The associated particle technique was used to eliminate background neutrons from the measurement. We conclude that because collimator-scattered neutrons constitute only a small part of the neutron flux in the field and most of the scattered neutrons have energies greater than 12 MeV, double-taper collimators are not necessary. (auth)

24433 EFFECTIVE CHARGE OF FISSION FRAGMENTS. Miterev, A. M.; Borisov, E. A. Sov. At. Energy (Engl. Transl.); 36: No. 4, 404-405(Apr 1974).

Translated from At. Energ. (USSR); 36: No. 4, 320-321(Apr 1974).

Besides "pure" ionization processes and elastic collisions with atoms of the medium, the passage of fission fragments through a medium is accompanied by exchange processes involving electrons and atoms of the medium. An expression for the effective charge was obtained which differed from the one usually used in its dependence on fragment charge. The results are compared with experimental data on the effective charges of fission fragments in H, He, air, Ar, and N. (1 figure) (RWR)

24434 ENERGY STRAGGLING OF ^4He IONS BELOW 2.0 MeV IN Al, Ni, AND Au. Harris, J.M.; Nicolet, M. (California Institute of Technology, Pasadena, California 91125). Phys. Rev. B 11: No. 3, 1013-1019 (1 Feb 1975).

Energy straggling of ^4He ions has been measured in thin films of Ni, Al, and Au. The observed straggling is roughly proportional to the square root of thickness and appears to have a slight energy dependence for all these materials. The results are compared with predictions of the theories of Bohr, Lindhard and Scharff, and of Chu and Mayer. Both the Ni and Au results are below the predictions of Bohr and are above the predictions of Chu and Mayer, and of Lindhard and Scharff. The Al measurements are above predictions of all these theories. (auth)

24435 ON THE DETERMINATION OF COLLISION CROSS SECTIONS BY NUCLEAR DOPPLER SHIFT. Hauser, U.; Neuwirth, W.; Pietsch, W.; Richter, K. (Koeln Univ. (F. R. Germany). 1. Physikalisches Inst.). Z. Phys.; 269: No. 2, 181-188(1974).

A report on measurements of the energy loss of ions in matter by "Inverted Doppler Shift Attenuation" (IDSA) is given. This new method is an inversion of the "Doppler Shift Attenuation" (DSA) method for the determination of lifetimes of nuclear states. While in DSA the exact knowledge of the velocity-dependent energy loss function dE/ds is required, it is shown that in IDSA this function or the absolute collision cross section can be determined from the Doppler spectrum of an excited nuclear fragment recoiling in matter, whose lifetime is known. No corrections or assumptions concerning the collision processes are necessary. $^7Li^*$ fragments (E_γ = 478 keV) from the $^{10}B(n,\alpha)^7Li^*$ reaction produce an easily observable and analyzable Doppler spectrum. Here boron must be a constituent or an implanted impurity of the material to be investigated. The experimental set-up is described. An exact relativistic analysis of the Doppler spectrum is given. The measured collision cross sections turn out (a) to be proportional to v within the range $1.5 \times 10^8 \leq v \leq 4.8 \times 10^8$ cm/sec, (b) due to pure "electronic" collisions only, and (c) sensitivity dependent on the charge distributions of the target atoms. (auth)

24436 COMMENTS ON FOIL EFFECTS IN BEAM-FOIL MEAN-LIFE MEASUREMENTS. Bickel, W. S.; Buchta, R. (Forskningsinstitutet foer Atomfysik, Stockholm). Phys. Scr.; 9: No. 3, 148-150(Mar 1974).

An investigation of carbon exciter-foil thickening which occurs during beam-foil measurements shows that time-dependent foil characteristics can cause serious intensity normalization problems. The energy lost by 80 keV Li^+ ions while travelling through carbon foils has been measured. (auth)

24437 ASYMPTOTIC CHARACTERISTICS OF THE SOLUTION OF THE TRANSFER EQUATION IN THE PROBLEM OF THE INHOMOGENEOUS LAYER. Germogenova, T. A.; Konovalov, N. V. Zh. Vychisl. Mat. i Mat. Fiz.; 14: No. 4, 928-946(1974). (In Russian).

Consideration is given to the problem of an asymptotic description of the intensity of monochromatic radiation reflected and transmitted by an inhomogeneous, plain-parallel medium, and to the sequence of events within this medium. The medium is assumed to consist of a number of different, optically thick, homogeneous layers in which scattering and absorption of radiation take place. (SJR)

24438 PRACTICAL APPLICATIONS OF HEAVY ION BEAMS. Flerov, G. N.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk; 114: No. 2, 351-373(Oct 1974). (In Russian).

The theoretical and practical aspects of the physics of heavy ions are briefly reviewed. A series of practical applications of

heavy ions, which appear to be the most promising are present, is examined. The applications discussed are ion implantation, preparation of high-temperature superconductors, simulation of radiation defects in reactor materials, nuclear filters, studies of the surface of materials, and uses in medicine and biology. (JSR)

24439 POSITRON DYNAMICS IN SOLIDS. Brandt, W. (New York Univ., N. Y. (USA). Dept. of Physics). Appl. Phys.; 5: No. 1, 1-23(Oct 1974).

The implantation and propagation of positrons in solids are discussed. Several examples for the application of the positron method in the study of solid state properties are presented. (auth)

24440 DIRECT SAMPLING FROM THE KLEIN–NISHINA DISTRIBUTION FOR PHOTON ENERGIES ABOVE 1.4 MeV. Koblinger, L. (Central Research Inst. for Physics, Budapest). Nucl. Sci. Eng.; 56: No. 2, 218-219(Feb 1975).

A direct sampling method in photon-transport calculations is presented which does not require approximations or weighting factors of the energy of the scattered photon provided the incident photon energy is greater than 1.4 MeV. The method can be used for high-energy-photon calculations where most of the approximate formulas are not applicable and the rejection technique is less efficient. (auth)

24441 PARTIAL WAVE EXPANSION OF THE INDUCED COLLISION KERNEL. Wienke, B. R. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 56: No. 2, 201-224(Feb 1975).

The angular expansion of the induced scattering term in the linear transport equation is given, and some simple implications are discussed. (auth)

24442 ELECTRON DEGRADATION SPECTRA IN HELIUM. Douthat, D. A. (Univ. of Chicago). Radiat. Res.; 61: No. 1, 1-20(Jan 1975).

Electron degradation and subexcitation spectra have been computed for helium gas containing a source of electrons with initial energy of 1.99, 10, or 30 keV. The yield of primary ionizations was also obtained and the results analyzed. A new type of plot illustrates the slow variation of the mean energy per ion pair with respect to the initial electron energy. (auth)

24443 TABULATION AND EMPIRICAL REPRESENTATION OF INFINITE-MEDIUM GAMMA-RAY BUILDUP FACTORS FOR MONOENERGETIC, POINT ISOTROPIC SOURCES IN WATER, ALUMINUM, AND CONCRETE. Morris, E. E.; Chilton, A. B.; Vetter, A. F. (Univ. of Illinois, Urbana). Nucl. Sci. Eng.; 56: No. 2, 171-178(Feb 1975).

Buildup factors for energy deposition in water and aluminum and for exposure in concrete are presented for monoenergetic, point isotropic gamma-ray sources. The buildup factors were evaluated using the method of moments and are tabulated for energies from 0.03 to 10 MeV and distances out to 50 mean-free-paths from the source. Empirical representations of these buildup factors are developed using Berger's formula. Fitting parameters are tabulated for each material as a function of source energy. (auth)

24444 COMPUTER CALCULATIONS OF X-RAY AND ^{60}Co-GAMMA DOSE RATE DISTRIBUTIONS. Application in Pendulum Beam Therapy. Lobodziec, W.; Szender, J. (Instytut Onkologii, Gliwice (Poland)). Postepy Fiz. Med.; 8: 179-186(1973). (In Polish).

The paper presents a method of calculating dose distributions in an irradiated medium, based on a minimal number of measuring data, such as the radiation source efficiency and the fractional decrease in the dose across the radiation beam. The method was used in calculating dose rate distributions with the aid of a computer for a pendulum motion of the radiation source. (auth)

Radiation Protection Standards

Refer also to abstract 24575.

24445 (CEA-R-4643) DESCRIPTION AND CHARACTERIZATION OF THE PHOTON NATIONAL PRIMARY STANDARDS BY ENERGY FLUX DENSITY, EXPOSURE, AND ABSORBED DOSE. Guiho, J. P.; Hillion, P.; Ostrowsky, A.; Wagner, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de Chimie). Dec 1974. 39p. (In French). Dep. NTIS (US Sales Only) $5.00.

It is absolutely necessary to establish for dosimetry purposes a coherent reference system which allows: connection of national and international intercomparisons, standardization of secondary references, survey and comparisons of different methods of measurement. For photon dosimetry, rather than choosing detectors as standards, the Bureau National de Métrologie has retained the γ beams themselves as primary references. Beams with energies covering the range of practical interest have been defined, each one being characterized by the dosimetric quantities used in the description of an ionizing radiation field: energy flux density, exposure and absorbed dose in a reference medium; such a system allows the establishment of the relations between the different ways of describing the same physical phenomena. Precisions of the beams definitions with exposure and absorbed dose lie between 1.1 and 1.7%. (auth)

24446 SAFETY MARGIN PROVIDED BY PRESENT STANDARDS IN CONNECTION WITH PROTECTION AGAINST IONIZING RADIATIONS. Bertin, M. Pollut. Atmos.; No. 62, 151-160(Apr 1974). (In French).

After a reminder of the method of "measuring" (in the radio protection field) the risks due to exposure, the relative importance of various exposures that we undergo and the prescribed limits are indicated. These limits are respected but, despite this, the damages that the nuclear industry would ineluctably cause, even in normal operating conditions were calculated. These calculations are based on assumptions contradicted by experimental data and clinical observations. The present standards therefore provide real safety; the accumulated data since their publication proves their cogency. (FR)

24447 RADONANVISNINGAR, ANVISNINGAR OM SKYDDSATGAEDDER MOT RADON OCH RADONDOETTRAR UNDER JORD I GRUVA OCH STE STENBROTT M,MM. (Directives Concerning Radon. Directives on Protective Efforts Against Radon and Radon Daughters Below Ground Level in Mines and Quarries, etc.). Stockholm; Kungl, Arbetarskyddsstyrelsen (1973). 78p.

Directives are given for the protection of miners and other personnel working in mines, quarries, rock chambers etc., against radioactive radon and radon daughters. Limits are given for acceptable expositions. Advice on dust minimizing, improvement of ventilation and breathing masks is given. Directives are given for the monitoring of the amount of radon and radon daughters and for health control of personnel. Finally the uranium-238 decay giving radon and radon daughters is described. General measuring methods, biological consequences of exposure, uranium and thorium and their most important minerals, calculation of circulation of air and sampling methods are also described. (SW)

24448 RELATIVE BIOLOGICAL EFFICIENCY AND RADIATION QUALITY FACTOR. Gajewski, T. (Akademia Medyczna, Lodz (Poland)). Postepy Fiz. Med.; 8: 187-189(1973). (In Polish).

The paper points to some irregularities in the formulations defining RBE and QF. RBE and QF are shown to be in fact reciprocals of some expressions found in some authors. (auth)

Radiation Source Calibration and Standardization

24449 CALIBRATION OF MILLICURIE GAMMA SOURCES USING GAMMA RAY SPECTROMETRY. Bihl, D.; Luckstead, S.; Skolil, L. L. (San Diego State Univ., CA). Health Phys.; 27: No. 6, 553-556(Dec 1974).

A method is proposed to calibrate γ sources using γ-ray spectrometry with a NaI(Tl) scintillation detector. Specific use is made of the detector efficiency and peak-to-total ratio to achieve absolute activity. Theory was applied to ^{137}Cs and ^{60}Co sources with resulting 95% confidence levels of about 4%. (auth)

24450 COMPARISON OF ACTIVITY AND POWER MEASUREMENTS OF A 1 Ci ^{60}Co SOURCE. Roux, A. M. (Service Central de Protection Contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Metrologia; 10: No. 3, 103-104(Sep 1974).

The results of the activity measurement of a 1-Ci ^{60}Co source made at the Bureau International des Poids et Mesures are compared to those of the power measurement of a similar ^{60}Co source performed at the National Bureau of Standards. For this comparison, the ratio of the activities of the two sources is determined; the method used is described and the errors are analyzed. The agreement between the activity and power measurements is excellent: the relative difference is less than 1×10^{-3}, which is not significant according to the estimated errors. (auth)

24451 A METHOD OF MEASURING THE ACTIVITY OF A 1 Ci ^{60}Co SOURCE. Roux, A. M. (Service Central de Protection Contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Metrologia; 10: No. 3, 99-102(Sep 1974).

A new method for measuring the activity of strong ^{60}Co sources is described. It is based on the precise experimental determination by gamma spectrometry of the activity ratio for two sources which are very different in strength but of identical geometry. After dissolution of the weak source its activity is measured by the absolute $4\pi\ \beta-\gamma$ coincidence method. The activity of the strong source is obtained from the activity ratio and the activity of the weak source. In this way, a 1-Ci ^{60}Co source has been compared with a 2-mCi source. The activity of the 1-Ci source is determined with an accuracy of about 0.2%. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 24665 and 24705.

24452 (INIS-mf-1383, pp 46-52) METHOD FOR CALCULATION OF THE PLANE-PARALLEL SHIELD WITH ACCURATE ACCOUNT FOR THE CROSS-SECTION RESONANCE STRUCTURE. Germogenova, T. A.; Ignatov, A. A.; Isaev, N. V.; Nikolsev, M. N. 1973. (In Russian).

An algorithm was described for the calculation of laminated shields. It was developed on the basis of the subgroup method which makes it possible to consider correctly the cross section resonance. The algorithm was developed with consideration of the scattering anisotropy. (tr-INIS)

24453 RECENT METHODS FOR TESTING GAMMA SHIELDS. Fourcade-Cancelle, N.; Papot, L. (CEN de Saclay, Gif-sur-Yvette, France). pp 953-972 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]). (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The shielding materials used are well known, but their efficiency may be reduced by some possibly imperfect construction. This efficiency is to be checked by testing; for this purpose, one will use well calibrated gamma sources and detectors of various types. From the measured dose rates, the shield is amended to bring its efficiency up to normal values. Sponsored by I.A.E.A. and AFNOR (French Standard Organization), an experimental work was performed by the C.E.A. in order to propose precise acceptance criterions, based on the actual consequences the defect may have for the staff. (FR)

24454 CHARACTERISTICS OF SECONDARY GAMMA RADIATION FROM THE HEAVY COMPONENT OF NUCLEAR REACTOR SHIELDING. Abagyan, A. A.; Vrazhnov, Yu. N.; Germogenova, T. A.; Degtyarev, S. F.; Dubinin, A. A.; Zhuravlev, V. I.; Kazansky, Yu. A.; Utkin, V. A. pp 538-578 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]). (In English and Russian).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The characteristics of secondary gamma emission resulting from neutron capture and inelastic scattering in various shielding materials are discussed. In order to obtain a detailed picture of the characteristics of secondary gamma emission, a combined system of transport equations for neutrons and gamma quanta is solved by the method of discrete ordinates. Correlations are investigated between neutron and gamma-quanta doses as a function of shielding thickness, spectrum and neutron angular distribution, etc. A comparison with the experimental results is presented. (FR)

24455 REDUCTION OF NATURAL RADIATION INTENSITY IN A LARGE STORAGE AREA. Schiager, K. J. (Colorado State Univ., Fort Collins). Health Phys.; 27: No. 5, 433-445(Nov 1974).

A large storage facility for sensitive photographic products was constructed by the Kodak Colorado Division of the Eastman Kodak Company. The theoretical calculations and experimental procedures that were used to optimize the construction in order to reduce the natural radiation background intensity to approximately half of its normal value are presented. Measurements made in the facility upon completion, approximately 11 μR/hr in the low-activity rooms compared with 22 μR/hr in similar rooms of normal construction, confirmed the attainment of the design objectives. The cost for the low-activity areas was $2.80 per square foot more than that for similar areas of normal construction. (auth)

24456 APPLICATION OF THE INVARIANT IMBEDDING METHOD TO THE PENETRATION PROBLEMS OF NEUTRONS. Nakai, M. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Japan); Komatsu, I.; Sato, Y.; Noguchi, F.; Shimizu, A.; Hada, M. pp 579-595 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

A one-dimensional neutron penetration calculation code, SLDN, has been developed. In the code, the penetration of fast neutrons is solved by the invariant imbedding method and the penetration of intermediate and slow neutrons is solved by the diffusion approximation method. Calculation of neutrons penetrating the multi-layer shield was performed with 30 group shielding constants generated from ENDF/B-I. The results were in good agreement with the results by the ANISN code for the corresponding geometry and the computing time was much less than that of the ANISN. The results were also in good agreement with measurements. (FR)

24457 STATUS REPORT ON NUCLEAR DATA FOR SHIELDING CALCULATIONS. Dunford, C. (IAEA, Vienna); Schmidt, J. J.; Froehner, F.; Valente, S.; Howerton, R. J.; Ozer, O. pp 1249-1296 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The nuclear data requirements for shielding applications as contained in the most recent first world-wide request list for reactor nuclear data measurements (RENDA 72) are reviewed. The availability of neutron cross section and photon production data relevant to shielding in the major evaluated nuclear data libraries are then surveyed. A brief description of present and planned major evaluation efforts is given. Further information is presented on methods, both experimental and theoretical, for obtaining photon production data. The report concludes with a discussion of the present knowledge of the prompt fission neutron spectra. (FR)

24458 GAMMA-RAYS TRANSPORT AT 6 AND 8 MeV. Johnson, W. R.; Thompson, W. L.; Risher, D. H.; Hassler, L. A.; Rogers, J. E. (Univ. of Virginia, Charlottesville). pp 1493-1509 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Experimental gamma-ray transmission and albedo measurements have been made in beam-geometry for photon energies of about 6 and 8 MeV. Results for low and medium atomic number shields are in agreement with analytical predictions. However, for the combination of high energy photon and high-Z shield, experimental values of transmitted dose and albedo are higher than would be calculated using standard techniques. A Monte Carlo program has been developed which simulated the coupled transport of gamma rays and electrons. The results of the code indicate a significant contribution to transmitted dose and albedo from bremsstrahlung for the combination of high energy source gamma rays and high atomic number shields. (FR)

24459 BENCHMARK DATA FOR HIGH ENERGY GAMMA PENETRATION. Bishop, G. B. (Univ. of Liverpool); Smitton, C.; Packwood, A. pp 1472-1492 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Benchmark data on the penetration of 6.13 MeV gammas through lead, iron and water have been obtained by experiment and calculation. The calculations were made using a Monte Carlo code McGID and the experimental data were obtained using the ^{16}N facility at the LIDO reactor, A.E.R.E. Harwell. The output from a scintillation gamma spectrometer system was analyzed using a newly developed unfolding code GAMAK. A design for an isotropic uniform disc source is presented. Details are given of a higher flux ^{16}N Radiation Facility under construction at the Universities Reactor Centre, Risley. (FR)

24460 COMPARISON OF NEW TRANSPORT CALCULATIONAL METHODS FOR REACTOR SHIELD DESIGN. Ganapol, B.; Herrnberger, V.; Paratte, J. M. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). pp 1444-1458 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Three transport calculational methods were compared with respect to accuracy and computation time for two deep neutron penetration problems in water. These methods were a mixed integral transport method without inner iteration, an accelerated Monte Carlo method and an S(N) bootstrapping technique. The results showed that compared to the S(N) technique the mixed integral

method is faster and the Monte Carlo method is comparable in computation time. (FR)

24461 EVALUATION OF NUCLEAR DATA AND COMPUTATIONAL METHODS FOR IRON AS A SHIELD MATERIAL. Malaviya, B. K.; Kaushal, N. N.; Becker, M.; Ginsberg, A.; Burns, E.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, NY). pp 1375-1387 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Experimental and analytical investigations of fast neutron transport in iron are discussed from the point of view of checking differential nuclear data useful in reactor shielding. Time-of-flight measured fast neutron angular flux spectra from different positions and directions in a clean, homogeneous iron assembly are analyzed using multigroup transport calculations, continuous slowing down theory and differential data from standard files as input to the calculations. A critical assessment of cross-section data files for iron is presented. (FR)

24462 FAST NEUTRON SPECTRUM MEASUREMENTS IN SPHERICAL IRON ASSEMBLIES. Williams, J. G. (London Univ.); Goddard, A. J. H. pp 1362-1374 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Energy spectra of fast neutrons leaking from the surface of spherical iron shells have been measured by the time-of-flight method. Shell thicknesses of 5.08 cm and 14.60 cm have been used. An inner polythene moderating shell has been used in conjunction with the 14.60 cm iron shell. With moderator present systematic errors did not exceed ±10% over the energy range 1 keV to 1 MeV and without moderator over the range 20 keV to 2 MeV. Measurements have been compared with Sn transport calculations in 100 groups using ENDF/BI data. (FR)

24463 SHIELDING FROM GAMMA RADIATION. Chapter 4. Kimel, L. R.; Mashkovich, V. P. pp 60-196 of Zashchita ot γ-Izlucheniya. Glava 4. Moscow; Atomizdat (1966). (In Russian).

This section in the handbook deals with problems of shielding from gamma radiation. Data are presented on the following aspects: cross-sections for the interaction of gamma radiation with matter, buildup factors, and dose fields from sources of various forms. Practical methods of calculating the shielding and backscattering of gamma radiation are briefly considered. The handbook may be useful to all those working with radioactive substances and sources of ionizing radiation. (tr-SJR)

24464 SHIELDING CALCULATIONS WITH COMPUTER FILES OF NEUTRON DATA. Froehner, F. H.; Valente, S. (NEA Neutron Data Compilation Centre, Gif-sur-Yvette, France). pp 1297-1313 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Existing evaluated neutron data on the total, differential elastic scattering, (n,γ), (n,p) and (n,α) cross sections of C, Na, Cr, Fe and Ni are reviewed. Information on additional unevaluated data is given which may be useful for shielding calculations, especially above 15 MeV. The problem of neutron windows is discussed in some detail and illustrated with recent ORELA data on iron. Finally, conversion codes for the three main files of evaluated data are reviewed. (FR)

24465 NUCLEAR DATA REQUIREMENTS FOR CALCULATING REACTOR SHIELDING. Abagyan, A. A.; Dubinin, A. A.; Suvorov, A. P. (Inst. of Physical Energy, Obninsk, USSR). pp 1316-1330 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The problem of nuclear data requirements is considered. The fact that for shielding purposes it is important to know the total cross-sections and elastic scattering indicatrices with a high degree of accuracy is discussed. The approximate accuracy of the required cross-sections for interaction between neutrons and nuclei is given and it is indicated that the nuclear data for the spectra of secondary gamma rays accompanying radiative capture, inelastic scattering, and certain other processes involved in the interaction between neutrons and nuclei are both inadequate and insufficiently accurate. (FR)

24466 ATTENUATION OF 14 MeV NEUTRONS IN SHIELDS OF CONCRETE AND PARAFFIN WAX. Bozyap, O.; Day, L. R. (North East London Polytechnic). Health Phys.; 28: No. 2, 101-109(Feb 1975).

The measurements made in determining the attenuation of 14-MeV neutrons in shields of concrete and paraffin wax are described. Measurements were made for fast and thermal neutrons using activation detectors and the results compared with calculations based on 2-group diffusion theory. Good agreement was obtained considering the limitations of the theory. Removal cross-sections and build-up factors were also measured using a different attenuation model. Values obtained for the removal cross-sections in concrete were lower than those reported by other authors. Other measurements are described in which neutron relaxation lengths are determined using a fixed source-detector geometry with different neutron detectors. Results agree reasonably well with those obtained by other authors. (auth)

24467 SPATIAL, ENERGY, AND ANGULAR DISTRIBUTIONS OF RADIATIONS IN REACTOR SHIELDING. Abagyan, A. A.; Bass, L. P.; Germogenova, T. A. (State Committee for Atomic Energy Research, Obninsk, USSR). pp 471-500 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]). (In English and Russian).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The characteristics of programs for the calculation of radiation fluxes by the method of discrete ordinates in plane one-dimensional and axisymmetric two-dimensional geometries are given. The calculation and experimental results for a wide range of shielding materials are compared. A description is given of an appropriate method for the experimental study of fast-neutron fields. (FR)

24468 BEHAVIOR OF REACTOR SHIELDING MATERIALS SUBJECTED TO NEUTRON IRRADIATION. Yvars, M.; Degas, P.; Quetier, M.; Rousseau, G. (CEN de Saclay, Gif-sur-Yvette, France). pp 664-681 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]). (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Different types of materials, as graphite, absorbing and unabsorbing graphitic carbons, boron carbide, have been developed for the shielding of fast neutron reactors. Their use has also been considered for other types of reactors, in particular high temperature reactors. Physicochemical properties of these materials, their composition, mechanical and thermal characteristics, desorption of occluded gases versus temperature are examined, as well as thermal shock properties of sintered boron carbides. Furthermore, the behavior of these different materials in molten sodium at 600°C has been examined with respect to the shielding of fast neutron reactors. Finally, all modifications of these properties, caused by neutron irradiation at 600°C and doses of about $8.10^{21} \cdot cm^{-2}$ (E > 0.1 MeV) are given. (FR)

24469 INVESTIGATIONS INTO THE GAMMA-RAY ATTENUATION IN CONCRETE SHIELDING WITH PIPES. Futtermenger, W. (Technische Univ., Hanover). pp 937-952 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The influence of void effects and streaming to the gamma-ray attenuation in concrete walls with built-in bundles of pipes was investigated with reference to the conditions in a fuel reprocessing plant. An infinite plane source was assumed with an angular distribution and spectrum corresponding to those at the surface of volume sources. The dose rates were calculated for straight and double staggered pipes. These calculations lead to the determination of conditions under which the use of double staggered pipes and heavy concretes is necessary. (FR)

24470 REACTOR SHIELDING AS A SOURCE OF RADIATION. Bolshakov, A. V.; Madeev, V. G.; Rudakov, A. N.; Uksusov, E. I. (Inst. of Atomic Energy, Moscow). pp 741-770 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]). (In English and Russian).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A method is developed for arriving at a two-component definition of the radiation flux within and beyond shielding. Consideration is given to reactor shielding as a source of scattered radiation. Experimentally derived parametric characteristics of the fast-neutron scattering function are given for various materials. The relationship between the scattering function and differential neutron cross-sections is analyzed. (FR)

24471 DATA ACTIVITY OF THE RADIATION SHIELDING INFORMATION CENTER. Roussin, R. W.; Trubey, D. K.; Maskewitz, B. F. (Oak Ridge National Lab., TN). pp 1191-1201 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The Radiation Shielding Information Center (RSIC) is involved in many data activities, with most emphasis being placed on nuclear cross section data. Through cooperation with various agencies, RSIC assists in improving the adequacy of basic evaluated cross section data and packages and distributes various types of data libraries useful in radiation transport analysis. The emphasis of the effort is on the improvement of calculational tools available to the shielding analyst. (FR)

24472 THEORETICAL STUDIES OF THE SENSITIVITY OF NEUTRON TRANSPORT IN IRON TO CROSS SECTION PROPERTIES. Goldstein, H.; Lidofsky, L. J.; Preeg, W.; Troubetzkoy, E.; Oblow, E.; Ching, J. (Columbia Univ., New York). pp 1202-1219 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The combined process of neutron transport and slowing-down in a thick shield is conceived of as motion in the six dimensional neutron phase space, comprising the ordinary three spatial coordinates plus the coordinates that specify neutron direction and energy. For given source, detector and shield geometry certain bundles of possible trajectories provide the favored paths for the neutron point to go from source to detector. The nature of the favored trajectories is determined by the characteristics of the neutron cross sections. Two applications to iron are envisaged: deep penetration from a 2 MeV source in an infinite block of iron and a moderately-thin leaky system with a 14 MeV spherical source (22 cm in radius) bounded by vacuum. (FR)

24473 SHIELDING OPTIMIZATION BY DIFFERENTIAL DYNAMIC PROGRAMMING METHOD AND EXPERIMENT. Kanai, Y. (Ship Research Inst., Tokyo); Yamaji, A.; Takeuchi, K. pp 456-470 of Fourth International Conference on Reactor Shielding. Paris; Eyrolles ([nd]).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Differential dynamic programming method is presented to determine the optimum shield system by optimizing a performance criterion, which is represented as a linear combination of three functions with respect to weight, cost, and thickness or dose, subject to certain constraints. A linear differential approximation is applied to the calculation of radiation attenuation, with 7 groups for both neutrons and gamma rays. The theoretical and experimental determination of the optimal configuration for a laminated iron–water shield are attempted. (FR)

24474 WALLS SHIELDING AGAINST IONIZING RADIATION. Lead Bricks. DIN 25407, No. 1 of German Norms. Koeln, F. R. Germany; Beuth (Feb 1974). (In German).

This standard contains specifications as to properties, basic shapes, classes and types of lead bricks. (GE)

24475 ADDITIONAL FEW-GROUP AND MULTIGROUP CALCULATIONS OF NEUTRON PENETRATION. Shure, K. (Westinghouse Electric, Corp., West Mifflin, PA). Nucl. Sci. Eng.; 56: No. 2, 219-224(Feb 1975).

Neutron penetration in water and through iron–water shields of practical interest obtained from P_3 multigroup calculations employing P_0-P_3 scattering components has been reasonably reproduced by P_3 11-group (10 nonthermal) calculations limited to P_0 and P_1 scattering components to which an extended transport approximation incorporating empirically determined cross-section adjustment factors is applied. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 23848, 23901, and 24561.

24476 (CONF-730660-P1) PROCEEDINGS OF THE 2ND INTERNATIONAL COLLOQUIUM ON GROUP THEORETICAL METHODS IN PHYSICS, JUNE 25–29, 1973, NIJMEGEN, NETHERLANDS. Volume 1. Morning Sessions. Janner, A.; Janssen, T. (eds.). (Katholieke Universiteit Nijmegen (Netherlands)). Sep 1973. 238p.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

There were 19 lectures. Separate abstracts were prepared for seven lectures. Other lectures were outside the scope of NSA. (JFP)

For abstracts of individual lectures see: 23837, 23934, 23988, 24007, 24477, 24493, and 24560.

24477 (CONF-730660-P1, pp A87-A106) PEDAGOGICAL ROLE AND EPISTEMOLOGICAL SIGNIFICANCE OF GROUP THEORY IN QUANTUM MECHANICS. Levy-Leblond, J. M. (Univ., Paris). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

Attention is called upon a fundamental aspect in the development of science, namely the constant remodeling processes by which a given body of knowledge is reshaped, beyond the original founding work. The apparently more routine practices of application and teaching, although often neglected in epistemological assessments, play a crucial role in implementing these processes. For specific historico-ideological reasons, which are briefly investigated, the necessary remodeling of quantum theory has been much too long delayed. The importance of group theory for supporting part of this task cannot be overestimated. This partial remodeling is sketched; relying heavily on galilean invariance, nonrelativistic quantum mechanics can be endowed with a group theoretical basis which replace the obsolete correspondence principle, and unify and strengthen the theoretical structure. Some uses of group theory for achieving these epistemological and pedagogical purposes are mentioned; one example is given for each of the functions performed; deepening foundations, getting rid of delusions, clearing up misunderstandings, and shaping open problems. (auth)

24478 (CONF-730660-P2) PROCEEDINGS OF THE 2ND INTERNATIONAL COLLOQUIUM ON GROUP THEORETICAL METHODS IN PHYSICS, JUNE 25–29, 1973, NIJMEGEN, NETHERLANDS. Volume 2. Afternoon Sessions. Janner, A.; Janssen, T. (eds.). (Katholieke Universiteit Nijmegen (Netherlands)). Sep 1973. 328p.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

There were 24 lectures included. Separate abstracts were prepared for eight lectures. Other lectures were outside the scope of NSA. (JFP)

For abstracts of individual lectures see: 23935, 24008, 24193, 24194, 24479, and 24494–24496.

24479 (CONF-730660-P2, pp B80-B107) APPLICATION OF THE THEORY OF LIE ALGEBRAS TO EXACTLY SOLUBLE QUANTUM SYSTEMS. Crubellier, A. (CNRS, Orsay, France). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

Starting from Miller's Lie algebraic interpretation of the properties of factorizable second order differential equations, the solutions of exactly soluble quantum systems are examined using group theory. These solutions are associated to basis functions of irreducible representations of the corresponding Lie algebras, and the normalization conditions are related to the unitarity of these representations. Tensor operators are then defined, which allows one to calculate some matrix elements of physical interest. This procedure is illustrated by some examples. (auth)

24480 (INIS-mf-1383, pp 12-22) GENERALIZED VARIATION-ITERATION METHOD FOR SEPARATION VARIABLES FOR KINETIC EQUATION SOLUTION. Sirotkin, A. M.; Khromov, V. V.; Slesarev, I. S. 1973. (In Russian).

The possibility of constructing a variational-iteration syntheses method was shown on an example of the solution of a one-dimensional gas kinetic equation. The basic concept of the method is that the solution is sought on a class of functions with the form $\phi(x_1x_2...x_k) = \sum_{m=1}^{N} \phi_{1m}(x_1)\phi_{2m}(x_2)...\phi_{km}(x_k)$. Together with the unlimited expansion the multiplicity of the functions at $N \to \infty$ is the basic advantage of the iteration-synthesis scheme: the application of only general limitations on the class of permissible functions and the absence of any a priori knowledge of the character of the solution. The kinetic equation is formulated by using the variational method in the one-group approximation in two-dimensional geometry. The conjugate functions are factored by the Legendre polynomials. Results were reported for the numerical verification of the effectiveness of the method proposed. (tr-auth)

24481 (ITEF-56) ANALYTICAL STRUCTURE OF PARTIAL DERIVATIVE OF HAMILTONIAN FUNCTIONS FOR RESTRICTED CIRCULAR THREE-BODY PROBLEM. Grebenikov, E. A.; Kiosa, M. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. (In Russian). INIS.

This article proves the theorem that the system of functional-differential equations, which is equivalent to the Hamilton-Yakobi equation for the limited problem of three bodies, cannot have analytical solutions which are represented by a sum, derivative or radical of the sum of arbitrary, differentiable real functions, each of which depends only on a single argument. (tr-SJR)

24482 SCHROEDINGER EQUATION WITH HAMILTONIANS PERIODIC IN TIME: SOLUTION BY INFINITE DETERMINANTS. Stey, G. C.; Gusman, G. (Brussels Univ. (Belgium). Faculte des Sciences). Phys. Lett., A; 50: No. 2, 111-112(18 Nov 1974).

Some of the exact results of an explicit solution of the Schroedinger equation with finite matrix hamiltonians periodic in time and whose elements are absolutely convergent Fourier series are presented. (auth)

24483 A CONTINUUM OF CONSERVATION LAWS FOR THE SINE-GORDON AND FOR THE KORTEWEG–de VRIES EQUATION. Steudel, H. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic)). Phys. Lett., A; 50: No. 2, 133-134(18 Nov 1974).

For both the sine–Gordon and the Korteweg–de Vries equation a continuum of conservation laws is derived from the equations defining the corresponding Bäcklund transformations. (auth)

24484 COMPATIBILITY OF THE SCHROEDINGER AND THE BORN INTERPRETATIONS OF THE WAVE FUNCTION. Casartelli, M. (Parma Univ. (Italy)); Galgani, L. (Milan Univ. (Italy). Istituto di Scienze Fisiche). Phys. Lett., A; 50: No. 3, 217-218 (2 Dec 1974).

Examples are shown to exist in which the Schroedinger and the Born interpretations are compatible. To this end, use is made of the Fenyes–Weizel–Nelson theorem and of known results of classical ergodic theory. (auth)

24485 VARIATIONAL EXPECTATION VALUES VIA PERTURBATION THEORY CORRECTIONS. Rodwell, W. R. (Sussex Univ., Brighton (UK)). Chem. Phys. Lett.; 29: No. 4, 516-520(15 Dec 1974).

The equivalence demonstrated by Cohen et al. between Delves' variational procedure and Dalgarno's perturbation method for calculating expectation values is shown to depend upon a specific choice of zero-order hamiltonian in the perturbation method. Theoretical considerations support the view that direct calculation of non-variational expectation values will yield results of a given accuracy more easily than either of the above methods, at least when only linear parameters are involved in the calculation. (auth)

24486 REPRESENTATION THEORY OF THE ICOSAHEDRAL GROUP. Backhouse, N. B. (Univ. of Liverpool); Gard, P. J. Phys., A (London); 7: No. 17, 2101-2108(21 Nov 1974).

A study is made of the representation theory of the icosahedral group I by exploiting the natural embeddings of the latter in the rotation groups in three and four dimensions. In particular it is shown that each irreducible representation of I is the restriction of some irreducible representation of SO(4), and that this enables the irreducible representations of I to be symmetrized. (auth)

24487 INVERSE OF A LINEAR OPERATOR. Haydock, R. (Cambridge Univ., Eng.). J. Phys., A (London); 7: No. 17, 2120-2124(21 Nov 1974).

The result of the inverse of a linear operator on a vector is

given by a recursion method which involves only three vectors at a time. The method is independent of any inner product. (auth)

24488 TWO-DIMENSIONAL HARMONIC OSCILLATOR MATRIX ELEMENTS, HYPERBOLIC ANGULAR MOMENTUM, AND SPHERICAL HARMONICS. Witschel, W. (Technische Univ., Brunswick). J. Phys., A (London); 7: No. 15, 1847-1857(11 Oct 1974).

Schwinger's coupled-boson representation of spherical and hyperbolic angular momentum is related to spherical harmonics and is used for the calculation of matrix elements. It is shown that radial matrix elements of the two-dimensional isotropic oscillator and the closely related hydrogenic matrix elements are proportional to 3j-symbols. Matrix elements of exponentials of hyperbolic angular momentum operators which form a formal analogy to the well known rotation matrices $d^{j}_{mm'}(\theta)$ and which are written as $t^{jj'}_{mm}(\theta)$ are derived. As only elementary algebra and some operator formulae are used, the algebraic method supplements analytical and group theoretic methods. (auth)

24489 ORTHOGONALITY RELATION FOR COVARIANT HARMONIC–OSCILLATOR WAVE FUNCTIONS. Ruiz, M.J. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 10: No. 12, 4306-4307 (15 Dec 1974).

Orthogonality relations for the Kim–Noz covariant harmonic–oscillator wave functions are discussed. It is shown that the wave functions belonging to different Lorentz frames satisfy an orthogonality relation. Furthermore, it is shown that for $n = m$ transitions there is a contraction factor of $(1 - \alpha^2)^{(n+1)/2}$ where α is the velocity difference between the two Lorentz frames. (auth)

24490 REMARK ON CAUSALITY AND PARTICLE LOCALIZATION. Hegerfeldt, G.C. (Institut für Theoretische Physik, Universität Heidelberg, Heidelberg, Germany). Phys. Rev. D 10: No. 10, 3320-3321 (15 Nov 1974).

We show that under quite general assumptions localization of particles in a finite space region at a given time is inconsistent with causality. The same holds for localization in a finite region of space–time. The derivation is short and very simple. (auth)

24491 SOME APPLICATIONS OF DILATATION INVARIANCE TO STRUCTURAL QUESTIONS IN THE THEORY OF LOCAL OBSERVABLES. Roberts, J. E. (Hamburg Univ. (F. R. Germany). 2. Inst. fuer Theoretische Physik). Commun. Math. Phys.; 37: No. 4, 273-286(Sep 1974).

In a dilatation-invariant theory it is shown that there is a unique locally normal dilatation-invariant state. Furthermore, a gauge transformation of a local algebra cannot be implemented by a unitary operator from the local algebra. If the local field algebras are factors, then so are the local observable algebras. The superselection structure of the theory can be determined locally. (auth)

24492 PRINCIPLES OF QUANTUM MECHANICS. Houston, W. V.; Phillips, G. C. Amsterdam; North-Holland Publishing Company (1973). 385p. $42.50.

The treatment of quantum mechanics covers the experimental necessity for quantum mechanics, analysis of classical mechanics, formulation of wave mechanics, characteristic states or eigenstates, the classical approximation, motion of a particle in a central field, methods of approximation, a general formulation of quantum mechanics, angular momentum and spin, systems of identical particles, and quantization of electromagnetic radiation in empty space. Also included are the interaction of radiation and matter, hydrogen-like spectra, two-electron spectra, quantum mechanical scattering theory, some special cases of scattering, quantum statistical mechanics, and electrons in solids. (auth)

Quantum Field Theories

Refer also to abstracts 23872, 23873, 23945, 23965, 24039, 24097, 24099, 24102, 24107, 24562, and 24565.

24493 (CONF-730660-P1, pp A213-A218) GAUGE COORDINATES. Barut, A. O. (International Centre for Theoretical Physics, Trieste, Italy). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

A quantum system with the symmetry group K has a natural imbedding into a system with the symmetry group $G \supset K$ by the introduction of gauge degrees of freedom. In particular, spin can be viewed as a gauge coordinate. (auth)

24494 (CONF-730660-P2, pp B15-B30) LAGRANGIAN QUANTUM THEORY. Bloore, F. (Liverpool Univ.). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

A principle of stationary action and a calculus of variations for the algebra of quantum mechanical observables are proposed. (auth)

24495 (CONF-730660-P2, pp B44-B58) TOPOLOGICAL GROUP EXTENSION PROBLEM: THE COMBINATION OF RELATIVISTIC COVARIANCE AND ELECTROMAGNETIC GAUGE INVARIANCE. Cattaneo, U. (Univ. of Rochester, NY). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The neutral component P_0 of the Poincaré group is combined with an electromagnetic gauge group J of m-times continuously differentiable maps of the Minkowski space into the reals ($0 \leq m \leq +\infty$). The groups G^f so obtained result from topological extensions of P_0 by J and are characterized by the factor sets f. Their structure is analyzed using a cohomology theory of topological groups. It is shown that all the groups G^f are topologically isomorphic to a semidirect product of P_0 by J. (auth)

24496 (CONF-730660-P2, pp B59-B66) SYMMETRY GROUPS OF ELECTROMAGNETIC FIELD TENSORS. Chen, L. C. (Univ., Nijmegen, The Netherlands). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

The relativistic symmetry group of a given electromagnetic field is defined as the largest subgroup of the Poincaré group which leaves the field tensor invariant. A simple and systematic method is presented for calculating the relativistic symmetry groups of uniform electromagnetic fields. The results are in a general form, they cover all the special cases of uniform electromagnetic fields. One also introduces two special infinitesimal generators of the relativistic symmetry groups, such that the two corresponding finite generators can be written in an explicit form. Since this method is based on the intrinsic properties of the electromagnetic field tensor, it certainly can be applied to more general cases. (auth)

24497 (IFVE-STF-73-60) INFRARED ASYMPTOTICS OF THE GREEN FUNCTION. Pron'ko, G. P.; Solov'ev, L. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 27p. (In Russian). INIS.

Within the axiomatic approach all model-independent terms of the infrared asymtotics of the Green function of a scalar charged particle were found. (tr-auth)

24498 (IFVE-STF-73-80) "BARE" CHARGE IN QUANTUM ELECTRODYNAMICS. Logunov, A. A.; Mestvirishvili, M. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 5p. INIS.

It was shown that if there is Callan-Lehmann representation in quantum electrodynamics, the bare charge becomes infinite. (tr-auth)

24499 ON INSTABILITY OF ASYMPTOTIC FREEDOM OF SUPERGAUGE YANG-MILLS THEORY. Suzuki, M. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 83: No. 2, 269-275(18 Dec 1974).

Asymptotic freedom is examined in detail for a simple supergauge symmetry model of Yang-Mills type. Although the model of perfect symmetry is asymptotically free, the symmetry limit is not realized as a local minimum in every direction in the parameter space of independent coupling constants if one starts with approximate supergauge symmetry. In spite of the unstable nature of the perfect symmetry limit, breaking due to soft operators explicitly or spontaneously does not ruin the asymptotic freedom. This leads to speculations on a new possibility of achieving the asymptotic freedom without massless particles in the ordinary Yang–Mills theory. (auth)

24500 MIXING OF OPERATORS IN WILSON EXPANSIONS. Sarker, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 82: No. 3, 447-460(4 Dec 1974).

The tree-loop theorem of 't Hooft and Veltman is used in Fermi type gauges to show that gauge invariant operators in Wilson expansions mix in general with non-gauge invariant operators. Background field gauges are proposed in which this does not occur. Calculations of anomalous dimensions in these gauges are discussed. (auth)

24501 DIMENSIONAL REGULARISATION AND BROKEN CONFORMAL WARD IDENTITIES. Sarkar, S. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 83: No. 1, 108-126(11 Dec 1974).

Dimensional regularization is used to give a simple treatment of broken conformal Ward identities. The method reproduces the known answers for standard theories. In addition it permits a derivation of the relevant identities for non-Abelian gauge theories which have not been obtained by other means. For the latter class of theories asymptotic scale invariance is found not to imply asymptotic conformal invariance for gauge variant Green functions. This is due to two gauge dependent insertions occurring in the identities. One can be predicted classically, whereas the other contains a new term dependent on Faddeev-Popov ghosts. (auth)

24502 FIELD THEORY RENORMALIZATION USING THE CALLAN-SYMANZIK EQUATION. Blaer, A. S. (Princeton Univ., N. J. (USA). Dept. of Physics); Young, K. (Chinese Univ. of Hong Kong, Shatin). Nucl. Phys., B; 83: No. 3, 493-514(25 Dec 1974).

Quantum electrodynamics (QED) is renormalized by exploiting the Callan-Symanzik equations for broken scale invariance. The basic idea is to make enough mass insertions in a Green function G requiring renormalization so that the resulting Green function G' is superficially convergent and has a skeleton expansion. G' is trivially renormalized and G is recovered through the Callahan-Symanzik equations. This offers a simple proof that QED can be multiplicatively renormalized. This technique avoids all divergent integrals, in particular the difficult overlapping divergences. Moreover, it is shown that the renormalized Green functions calculated according to the recipe given by Bogoliubov, Parasiuk and Hepp agree with the result of the present analysis. This offers an alternate and somewhat simpler proof that the BPH method gives a finite answer and corresponds to a multiplicative renormalization. The method used is generalizable to other field theories in an obvious manner. (auth)

24503 CAUSALITY IN QUANTUM FIELD THEORY WITH NONLOCAL INTERACTION. Alebastrov, V. A.; Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Commun. Math. Phys.; 38: No. 1, 11-28(Oct 1974).

2 figs.; 13 refs.

It is proved that the S-matrix satisfies the Bogolubov microcausality condition in each order in perturbation theory in a quantum field theory with nonlocal interaction, where the nonlocality is introduced with the help of form factors being entire analytical functions of the order $\frac{1}{2}$. (auth)

24504 BOREL STRUCTURE IN OPERATOR ALGEBRAS. Pedersen, G. K. Kgl. Dan. Vidensk. Selsk., Mat.-Fys. Medd.; 39: No. 5, 1-13(1974).

Abstract measure theory is often described as the study of the two classes C(X) and B(X) consisting, respectively, of the continuous and the Borel measurable functions on a locally compact space X. A measure μ on X is a functional on C(X) and it can be extended to B(X), thus giving rise to various normed spaces, in particular $L^1_\mu(X)$ and $L^\infty_\mu(X)$. Certain aspects of noncommutative measure theory are considered. In that version C(X) is replaced by a noncommutative C*-algebra A, and the Borel algebra B associated with A replaces B(X). Instead of $L^\infty_\mu(X)$ one must now accept any von Neumann algebra M for which there is a representation π of A into M such that $\pi(B) = M$. In a certain sense it can be said that π replaces μ. It is shown that for each locally compact group G of automorphisms of a von Neumann algebra M there is an essentially unique C*-algebra A with Borel algebra B and a representation π with $\pi(B) = M$, such that G can be realized as a Borel group of automorphisms of B. This generalizes classical lifting theorems by J. von Neumann and G. W. Mackey. The probelm arises (in connection with model quantum field theory) whether a group G of automorphisms of M can be lifted to the Borel algebra B of an arbitrary C*-algebra A with a representation π such that $\pi(B) = M$. This is answered in the affirmative when G is countable or has uniformly continuous action on M. (auth)

24505 STATISTICAL MECHANICS OF ONE-DIMENSIONAL GINZBURG-LANDAU FIELDS. Feynman Graph Evaluation of the Screening Approximation (n^{-1} Expansion). Bray, A. J. (Univ. of Maryland, College Park). J. Phys., A (London); 7: No. 17, 2144-2151(21 Nov 1974).

The free energy per component of an isotropic one-dimensional Ginzburg-Landau field with n components is calculated to order n^{-2} by evaluating the appropriate Feynman graphs. The result agrees with that of Ferrell and Scalapino (Phys. Rev.; A9: 846-67 (1974)), obtained by solving the equivalent anharmonic oscillator problem, but the method has greater generality. (auth)

24506 ELEMENTARY STATISTICAL MECHANICS OF A RELATIVISTIC GAS IN THERMAL EQUILIBRIUM. Kraus, K. (Univ., Wuerzburg, Ger.); Landsberg, P. T. J. Phys., A (London); 7: No. 17, 2130-2143(21 Nov 1974).

Starting from an assumption of ergodicity, the macroscopic description of a relativistic gas in terms of an energy-momentum tensor and four-currents for different particle types is obtained by summation over particles and time averaging. As a result of relativistic particle kinematics the formalism becomes covariant, and ergodicity as defined is shown to be a Lorentz invariant concept. (auth)

24507 CLASSICAL MOMENT PROBLEM AND QUANTUM FIELD THEORIES IN TWO SPACE-TIME DIMENSIONS. McClary, W. K. Toronto; Univ. of Toronto (1972). 84p.

Thesis.

Mathematical methods mainly inspired by the classical moment problem and the theory of Jacobi matrices are used to obtain criteria for self adjointness, and methods of solving operator equations for unbounded operators. These ideas are applied to relativistic scalar quantum field theory models in two-dimensional space-time with polynomial self-interactions to give elementary proofs of the existence of such models and to calculate vacuum state vectors and energies of the locally correct Hamiltonians from the coefficients of their divergent perturbation series. (auth)

24508 RELATIVISTIC ANGULAR MOMENTUM FOR ASYMPTOTICALLY FLAT EINSTEIN-MAXWELL MANIFOLDS. Bramson, B. D. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A; 341: No. 1627, 463-490(14 Jan 1975).

Treating general relativity as a Yang-Mills theory based on Lorentz invariance of the second kind leads to the derivation of six spin currents, which are linear combinations of the Ricci rotation coefficients, together with a Gauss theorem for the integrated charges. For asymptotically flat Einstein-Maxwell manifolds these charges are calculated by performing two-surface integrals at future null infinity. The gauge dependence of these charges, which arises because the underlying group is non-Abelian, is removed by making a canonical alinement of the asymptotic frames of reference. The Lorentz generators then arise as a field in asymptotic spin space and defined on the set of all outgoing null cones, which is the carrier space of the B. M. S. group. In the absence of outgoing gravitational radiation the Lorentz generators transform under translations as a moment of momentum. However, the points about which moments are taken belong not to the original Riemannian manifold but rather to a four-parameter family of cones isomorphic to Minkowski space-time. From the angular momentum structure there arises a natural twistor structure. Points on the twister and the center of mass of the system are defined as world lines in the manifold of cones. The remainder is devoted to formulating physical laws in cone space. These include a Poynting's theorem for the radiation of spin. (auth)

24509 VYRKHU RAZLOZHENIETO NA KLEBSH-GORDAN ZA GRUPATA O(2h + 1,1). (Clebsh-Gordan Expansion for the Group O(2h + 1,1)). Dobrev, V.; Petkova, V.; Todorov, I.; Mack, G.; Petrova, S. Sofia; Komitet za Mirno Izoolzuvane na Atomnata Energiya (1974). vp.

From second national conference of the young physicists; Sofia Bulgaria (10 Apr 1974).

The direct-product decomposition of two unitary representations of the supplementary series of O(2h + 1,1) is studied in detail. Invariant bi-linear forms are written down for arbitrary symmetric tensor representations and necessary and sufficient conditions are found for their positivity. Normalized Clebsch-Gordan kernels are evaluated explicitly and the Plancherel formula is verified. The results are applied elsewhere for the diagonalization of conformal covariant dynamical equations for the Euclidean Green functions. They are related to the derivation of covariant operator product expansions. (auth)

24510 TOWARDS A FIELD THEORY OF HADRON BINDING. Blaha, S. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850). Phys. Rev. D 10: No. 12, 4268-4277 (15 Dec 1974).

A field-theoretic model for hadron binding is described in which free quarks are totally screened. Quarks interact via a dipole vector-gluon field. A second-quantization procedure for the gluon field, which reduces the field to an embodiment of a direct particle interaction, eliminates unitarity problems. A detailed description of perturbation-theory rules is given. In contrast to the results of the pseudoscalar-meson and massive-vector-meson models (without cutoff) scaling occurs in the electroproduction structure functions. Another possible model having some resemblance to the relativistic harmonic-oscillator quark model of Feynman, Kislinger, and Ravndal is also described. It is unitary and has scaling structure functions. (auth)

24511 DERIVATION OF RELATIVISTIC THREE-DIMENSIONAL FORMALISMS FROM THE

BETHE–SALPETER EQUATION. Klein, A. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19174); Lee, T. H. Phys. Rev. D 10: No. 12, 4308-4312 (15 Dec 1974).

A theoretically complete relativistic three–dimensional formalism was first derived from the Bethe–Salpeter equation by Lévy, Klein, and Macke. Two new derivations of this work are given with the aim of clarifying its close connection but nonidentity with various popular alternative formalisms of more recent vintage. Insofar as possible, the merits of the various formalisms are presented. (auth)

24512 FEYNMAN–DYSON RULES IN PARAMETRIC SPACE. Cvitanović, P.; Kinoshita, T. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853). Phys. Rev. D 10: No. 12, 3978-3991 (15 Dec 1974).

Concise and practical formulas for Feynman–parametric integrals are assembled and presented in the form of Feynman–Dyson rules in parametric space. These rules enable us to write down S–matrix elements directly in terms of some parametric functions. They are particularly useful for construction of ultraviolet– and infrared–divergence–free Feynman–parametric integrals in a form suitable for numerical integration. (auth)

24513 NEW APPROACH TO THE SEPARATION OF ULTRAVIOLET AND INFRARED DIVERGENCES OF FEYNMAN–PARAMETRIC INTEGRALS. Cvitanović, P. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14853; Kinoshita, T. Phys. Rev. D 10: No. 12, 3991-4006 (15 Dec 1974).

A scheme for systematically separating ultraviolet divergences of Feynman amplitudes in parametric space is developed. It is summarized by an explicit formula which enables us to incorporate readily the ultraviolet–finite remainders thus constructed into the usual renormalization scheme. It is shown further that infrared divergences can be treated in a very similar way. Our method is particularly suitable for numerical integration. (auth)

24514 STATISTICS OF CLASSICAL BLACKBODY RADIATION WITH GROUND STATE. Theimer, O. (New Mexico State University, Research Center, Las Cruces, New Mexico 88003); Peterson, P.R. Phys. Rev. D 10: No. 12, 3962-3971 (15 Dec 1974).

A classical model of blackbody radiation is investigated in which the field is produced by N_T incoherent thermal sources and N_0 incoherent sources of a ground state with Lorentz–invariant spectral energy density proportional to the frequency ω. Bundles of $2/\mathcal{N}$ nearly monochromatic, nearly parallel cavity modes are considered, and general formulas for all moments of the energy density ρ_b and the energy H_b in a bundle are derived by the use of the central limit theorem. It is found that the energy H of one cavity mode is a fluctuating quantity because of interference of the field contributions from different sources. This causes an energy distribution $W(H) = \langle H\rangle^{-1}\exp(-H/\langle H\rangle)$ which is formally different from the canonical energy distribution. The moments $\langle H^q\rangle$ obtained from W(H) agree with those obtained by quantum statistics for $q = 1$ and $q = 2$, but disagree for $q > 2$; the higher moments are also inconsistent with some general relations of the canonical ensemble theory. Suggestions are made for achieving full equivalence between the classical model and quantized blackbody radiation. (auth)

24515 COVARIANCE OF THE RARITA–SCHWINGER FIELD WITH QUANTIZED SCALAR–FIELD INTERACTION. Hagen, C.R. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). Phys. Rev. D 10: No. 12, 3972-3977 (15 Dec 1974).

The vector–spinor formulation of the mass–m spin–3/2 field is extended to include a coupling to a scalar field ϕ through the replacement $m \rightarrow m + g\phi$. The commutation relations of the resulting system are determined and the customary absence of positive–definiteness of the canonical anticommutators displayed. The generators of the transformations of the Poincaré group are determined, together with their commutators with the canonical variables of the theory. It is seen that the system does indeed transform covariantly, thereby demonstrating that the appearance of indefinite metric need not imply the frequently inferred breakdown of Lorentz invariance. (auth)

24516 FIELD THEORY OF SPINNING STRINGS. Kaku, M. (Department of Physics, The City of College of the City University of New York, New York, New York 10031). Phys. Rev. D 10: No. 12, 3943-3956 (15 Dec 1974).

We present the field theory of spinning strings, which is a natural generalization of the field theory of Dirac particles. Because we place spinors along a string defined at each space–time point, the theory is at once multilocal and reproduces an infinite–component field theory. We introduce interactions by allowing the string to execute well–defined topological transformations and show that we reproduce the usual dual models of Neveu, Schwarz, and Ramond. We give the full Lagrangian which yields S matrices which are dual, factorizable, Lorentz–invariant, crossing–symmetric, and probably renormalizable. (auth)

24517 CRITICAL BEHAVIOR IN A CLASS OF O(N) –INVARIANT FIELD THEORIES IN TWO DIMENSIONS. Jacobs, L. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 10: No. 12, 3956-3962 (15 Dec 1974).

Critical behavior in a class of two–dimensional field theories which exhibit dynamical symmetry breaking at zero temperature is analyzed in the 1/N approximation. We show that, in the case of an O(N) –invariant theory of massless, N–component, Fermi fields, a phase transition takes place in the limit as N goes to infinity. The critical temperature, above which the model becomes symmetric, is given in terms of the induced fermion mass at zero temperature, m^0_f, as $m^0_f\beta_c = 1.764$. The equivalence between the critical parameters of the theory and those predicted by the BCS theory of superconductivity is established. We show that the BCS gap equation follows from the stability conditions imposed on the effective potential. The phase transition is discussed in a thermodynamical analog of the model. The analysis of the symmetry behavior of the theory is carried out by functional methods. (auth)

24518 ASYMPTOTIC FREEDOM AND FINITENESS OF THE WAVE–FUNCTION RENORMALIZATION CONSTANT. Hosoya, A. (Department of Physics, Osaka University, Toyonaka, Japan). Phys. Rev. D 10: No. 12, 3937-3942 (15 Dec 1974).

It is shown that a particle field is asymptotically free in the ultraviolet limit if the wave–function renormalization constant corresponding to the field is a nonvanishing function of coupling constants. In the proof we postulate the positivity of the Källén–Lehmann spectral function and the renormalizability of the theory. (auth)

24519 NONPERTURBATIVE METHODS AND EXTENDED–HADRON MODELS IN FIELD THEORY. III. FOUR–DIMENSIONAL NON–ABELIAN MODELS. Dashen, R.F.; Hasslacher, B.; Neveu, A. (The Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 12, 4138-4142 (15 Dec 1974).

By analogy with the magnetic vortex of the Landau–Ginzburg theory of superconductivity, we construct extended models of hadrons with SU(2) Yang–Mills fields coupled to fermions and a spontaneous–symmetry–breaking scalar isospinor. These models are in four space–time dimensions. (auth)

24520 NONPERTURBATIVE METHODS AND EXTENDED–HADRON MODELS IN FIELD THEORY. II. TWO–DIMENSIONAL MODELS AND EXTENDED HADRONS. Dashen, R. (The Institute for Advanced Study and Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Hasslacher, B.; Neveu, A. Phys. Rev. D 10: No. 12, 4130-4138 (15 Dec 1974).

We discuss the application of semiclassical quantization methods to two–dimensional model field theories for which exact nontrivial classical solutions are known analytically. This yields results which cannot be reached by ordinary perturbation methods. In particular, we obtain extended objects which can be considered as prototypes for hadrons. We study their quantum corrections and renormalization. We also develop a method for including fermions. (auth)

24521 NONPERTURBATIVE METHODS AND EXTENDED–HADRON MODELS IN FIELD THEORY. I. SEMICLASSICAL FUNCTIONAL METHODS. Dashen, R. (Institute for Advanced Study, Princeton, New Jersey 08540 and Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Hasslacher, B.; Neveu, A. Phys. Rev. D 10: No. 12, 4114-4129 (15 Dec 1974).

This is the first of a series of papers on the use of semiclassical approximations to find particle states in field theory. The meaning of the WKB approximation is examined from a functional–integral approach. Special emphasis is placed on the distinction between a true WKB or semiclassical approach and the weak–coupling approximation to it. Other topics include the center–of–mass motion of particle states and some problems special to field theory such as multiple–particle states, statistics, and infinite–volume systems. Ultraviolet divergences are touched on, but are dealt with more thoroughly in the following paper where specific models are examined. The central result of this series is that certain kinds of nonlinear field theories have extended particle solutions which survive quantization. The most interesting of these objects, which are reminiscent of hadrons, come from theories with spontaneous symmetry breaking. (auth)

24522 RENORMALIZATION OF SPINOR AND SCALAR ELECTRODYNAMICS WITH BILINEAR GAUGE CONDITIONS. Joglekar, S.D. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510. Phys. Rev. D 10: No. 12, 4095-4113 (15 Dec 1974)

We apply the recently developed technique of Ward–Takahashi identities for proper vertices in gauge theories to the problem of renormalization of electrodynamics—as a simple example of a gauge theory—when the guage condition chosen is bilinear in fields. We show that spinor electrodynamics is renormalizable when the gauge condition is $f[A] \equiv (1/\sqrt{\alpha})(\partial_\mu A^\mu - 1/2\xi A^3) = 0$, where ξ and α are the real and arbitrary, and parameter ξ is renormalized independently. We also show

that scalar electrodynamics is renormalizable with the gauge condition $f[A] \equiv (1/\sqrt{\alpha})(\partial_\mu A^\mu - 1/2\xi\eta A^2 - 1/2\eta\phi^*\phi) = 0$, where ξ and η are real and arbitrary. ξ and η must be renormalized independently. (auth)

24523 ARE TWO-DIMENSIONAL YANG-MILLS GAUGE THEORIES "COLOR" DEPENDENT? Li, L.; Willemsen, J. F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev., D; 10: No. 12, 4087-4094 (15 Dec 1974).

If the symmetry of the theory under global transformations generated by the charges is normal, the physical states of the system must be "color" singlets. (This is analogous to the physical states of two-dimensional quantum electrodynamics being neutral.) Consequently, the local color currents vanish in physical states. The (two-dimensional) inhomogeneous Lorentz invariance of the theory is also discussed. (auth)

24524 BHABHA FIRST-ORDER WAVE EQUATIONS: I. C, P, AND T. Krajcik, R. A.; Nieto, M. M. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev., D; 10: No. 12, 4049-4063(15 Dec 1974).

We discuss properties of Bhabha first-order wave equations for arbitrary spin, of which the Dirac and Duffin-Kemmer-Petiau (DKP) equations are special examples. The C, P, and T transformation matrices for the Dirac field are reviewed in various representations, and the C, P, and T transformation matrices for the DKP and general Bhabha cases are then derived. The Bhabha transformation matrices are polynomials of order 2S in the algebra matrices, where S is the maximum spin of a particular Bhabha algebra. For the cases S = 1 and ½ they reduce to the DKP and Dirac transformation matrices. We also discuss C, P, and T for the Sakata-Taketani (ST) reduction of the DKP equation, and explicitly exhibit the "subsidiary component" ST Hamiltonian equation, as well as the known "particle component" ST equation. Throughout we emphasize that physical insight which can be gained from the use of the first-order Bhabha formalism, including a possible connection between meson nonconservation and CP violation. (auth)

24525 RENORMALIZATION-GROUP SUM RULES AND THE CONSTRUCTION OF MASSLESS FIELD THEORIES $4-\epsilon$ DIMENSIONS. Sugar, R.L.; White, A.R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 10: No. 12, 4063-4073 (15 Dec 1974).

We study massless ϕ^4 field theory and the Reggeon calculus with Pomeron intercept 1, in $4-\epsilon$ dimensions. We present sum rules which give the full propagator and the bare mass (or intercept) as integrals over the remaining (finite) renormalization constants of these theories. When an infrared-stable Gell-Mann-Low eigenvalue exists these sum rules can be used to extract the infrared behavior of the propagator. They can also by used to show that the perturbation series is an asymptotic expansion for small values of the coupling constant and large values of the momentum. The sum rules can be combined with the Schwinger-Dyson equations for each theory to give a perturbative construction of the Green's functions which is free of infrared divergences. (auth)

24526 CONSTRUCTION OF THE REGGEON CALCULUS IN $4-\epsilon$ DIMENSIONS. Sugar, R.L.; White, A.R. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). Phys. Rev. D 10: No. 12, 4074-4087 (15 Dec 1974).

We study the Reggeon field theory in $4-\epsilon$ dimensions. When the Pomeranchuk singularity has intercept 1, the theory cannot be renormalized order by order in the perturbation series. Nevertheless we are able to develop systematic techniques for constructing the Pomeranchuk Green's functions. An integral representation is obtained for the Pomeranchuk propagator which allows us to explicitly display its infrared ($l \simeq 1$, $t \simeq 0$) behavior and to show that the perturbation series is an asymptotic expansion for small values of the coupling constant and for large values of the angular momentum or momentum transfer. We also obtain an integral representation for the intercept renormalization counterterm. We find that for the renormalized Pomerachuk singularity to have intercept 1, the bare Pomeranchuk pole must have intercept greater than 1. (auth)

24527 FERMI QUANTIZATION OF NON-ABELIAN GAUGE THEORY. Loos, H.G. (Department of Mathematics, The Cleveland State University, Cleveland, Ohio 44115). Phys. Rev. D 10: No. 12, 4032-4048 (15 Dec 1974).

The Yang-Mills field coupled to spinors is quantized, using a gauge-invariant Fermi addition to the Lagrangian, by introducing classical fictitious fields. Problems arising in the Fermi method are investigated. Use is made of the Schrödinger representation, which may be seen as the differential equivalent of the path-integral method. In this representation the conditions selecting good states are very simple: Good states are gauge-invariant functionals of the spatial Yang-Mills potentials $b_a(\vec{x})$. The divergence in the naive scalar product of states is removed by the Faddeev-Popov factorization, and also by the cutoff method. Both methods produce gauge- and Poincaré-invariant results. The Faddeev-Popov weight is expressed in a power series, which converges in the whole coupling-constant plane, by seeing this weight as a Fredholm determinant. The consistency problem of the Fermi method is resolved by allowing certain operators to be self-adjoint; it is shown that gauge transformations cannot be implemented unitarily outside the good state space. We investigate the question which operators raise charge multiplets of good states from the vacuum. It is shown that this is done by the Mandelstam-displaced operators ψ, $\bar{\psi}$, B, and Π, and also by the potentials b_g which represent gauge-equivalence classes of Yang-Mills potentials, if the b_g form a linear subspace of the configuration space. In a gauge-invariant theory involving gauge-variant operators, the energy-momentum operators, defined as displacement operators, cannot be gauge-invariant. However, the effect of these operators in G is the same as that of certain gauge-invariant operators, and they can be used as the physical energy-momentum. Double commutators of these operators with the potentials are found to satisfy an identity which has a formal consequence for the mass of states raised from the vacuum by the potentials. (auth)

24528 IS THE POMERON A GOLDSTONE BOSON? Pinsky, S.S.; Rabl, V. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). Phys. Rev. D 10: No. 12, 4177-4180 (15 Dec 1974).

A Reggeon field theory is proposed using as an input two exchange-degenerate mesonlike trajectories, each of them corresponding to a pair of conjugate poles. A pomeron and a lower-lying Reggeon are generated by spontaneous symmetry breaking. Both the input and output trajectories have a $\sqrt{t}$ dependence and are complex for $t < 0$, reflecting the conventional treatment of Regge-pole-cut collisions. The gauge symmetry of the model is briefly discussed, and the model is compared with earlier work. (auth)

24529 (1 + 1) -DIMENSIONAL MODELS OF QUARK CONFINEMENT AND FINAL STATES IN DEEP-INELASTIC SCATTERING. Kogut, J. (Laboratory of Nuclear Studies, Cornell University, Ithaca, New York 14850); Sinclair, D.K. Phys. Rev. D 10: No. 12, 4181-4197 (15 Dec 1974).

Recently (1 + 1) -dimensional quantum electrodynamics has been considered as a model for quark confinement. We calculate the inclusive spectra and multiplicities for deep-inelastic electroproduction and e^+e^- annihilation, and verify the Drell-Yan threshold relations for this model. These analyses are extended to other soluble (1 + 1) -dimensional models of quark confinement. The first is electrodynamics with an additional massive vector gluon. In this theory one can examine the effect of a high-mass threshold on scaling. The theory has a precocious intermediate scaling region below the new threshold in addition to a true canonical asymptotic scaling region. The second model is the quantum electrodynamics of the Thirring model. This is a renormalizable theory which is scale-invariant at short distances. In it one can examine the effect that varying the strength of the short-distance singularity has on inclusive spectra and multiplicities. (auth)

24530 HIGHER-ORDER $\in$ TERMS IN REGGEON FIELD THEORY. Bronzan, J.B. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510); Dash, J.W. Phys. Rev. D 10: No. 12, 4208-4217 (15 Dec 1974).

We calculate the $O(\epsilon^2)$ terms of the Wilson expansion of the critical exponents in the Reggeon field theory with a bare linear trajectory and a triple-Regge interaction. We find that the $O(\epsilon^2)$ and $O(\epsilon)$ terms are comparable at $\in = 2$, and we obtain $\sigma_{tot}(s) \underset{s\to\infty}{\sim} (\ln s)^{0.38}$. We also show that the Gell-Mann-Low function β (g) expanded to finite order in both ϵ and g carries no information about the existence of the Gell-Mann-Low zero at finite ϵ. (auth)

24531 SPECTRAL FORMS FOR THE PHOTON PROPAGATION FUNCTION AND THE GELL-MANN-LOW FUNCTION. Milton, K.A. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 10: No. 12, 4247-4251 (15 Dec 1974).

An analysis by Schwinger is extended to prove that the Gell-Mann-Low function ψ is proportional to the spectral function σ for the photon propagation function when the latter is expressed as a function of a suitably defined effective charge in the asymptotic region. In terms of the correspondingly defined effective charge variables $\psi(\bar{e}_M^{\,2}) = (d\bar{e}_M^{\,2}/de_M^{\,2})e_M^{\,4}\sigma(e_M^{\,2})$. This equality reflects the difference between the effective-charge definitions of Gell-Mann and Low and of Schwinger. Thus, in the new variables, the Gell-Mann-Low equation holds in terms of the function $x^2\sigma(x)$. Moreover, it is possible to define a variable $y(x)$ such that $\psi(y) = x^2\sigma(x)$. The possibility of using alternative spectral functions to replace ψ is discussed in an appendix. (auth)

24532 GAUGE INVARIANCE AND MASS. Brandt, R.A. (Department of Physics, New York University, New York, New York 10003); Wing-Chiu, N. Phys. Rev. D 10: No. 12, 4198-4208 (15 Dec 1974).

The invariance of a theory involving a vector field $A_\mu(x)$ under local gauge transformations $A_\mu(x) \to A_\mu(x) + \partial_\mu\Lambda(x)$, etc., for all

c-number functions $\Lambda(x)$ is some gauge group $\mathcal{G}$, does not imply that the theory contains a zero-mass gauge particle. It is shown that what is relevant to the existence of zero-mass excitations is not the existence of $\mathcal{G}$ but the presence in $\mathcal{G}$ of the simple gauge functions $\Lambda(x) = R(x) \equiv r \cdot x$, r_μ = constants, under which $A_\mu(x) \to A_\mu(x) + r_\mu$. If $R(x) \in \mathcal{G}$, then the transverse gauge particle propagator has a singularity at zero mass. This result, and similar results for the other proper vertex functions, are deduced by both structural and functional methods. In conventional Lorentz-gauge four-dimensional QED, $R \in \mathcal{G}$ and so the physical photon can be interpreted as a Goldstone boson arising from the spontaneous breakdown of the R-transformation invariance. In two-dimensional massless QED (Schwinger model), $R \in \mathcal{G}$ and so there the photon can be (and is) massive. The point is further illustrated in other two-dimensional soluble models and four-dimensional perturbative models. (auth)

24533 GOLDSTONE AND PSEUDO-GOLDSTONE BOSONS IN UNIFIED GAUGE-FIELD MODELS. de Wit, B.; Pi, S.Y.; Smith, J. (Institute for Theoretical Physics, State University of New York, Stony Brook, Long Island, New York 11794). Phys. Rev. D 10: No. 12, 4303-4306 (15 Dec 1974).

We give a group-theoretical reason why in certain models the neutral pion remains massless to all orders in perturbation theory. This is an important constraint for the construction of realistic unified gauge-field models with pseudo-Goldstone bosons. (auth)

24534 GOLDSTONE AND QUASI-GOLDSTONE BOSONS IN MASSLESS AND MASSIVE ELECTRODYNAMICS. Haller, K. (Department of Physics, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. D 10: No. 12, 4299-4303 (15 Dec 1974).

Comment is made on the modifications that are required in the demonstration that Goldstone bosons exist in electrodynamics in order to accommodate the indefinite metric of the underlying space and the infinite range of the theory. (auth)

24535 RELATIVISTIC MOTION IN A UNIFORM MAGNETIC FIELD. II. Herrera, J.C. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. D 10: No. 12, 4297-4298 (15 Dec 1974).

The solution to the Lorentz-Dirac equation for a particle moving in a uniform magnetic field is developed with the coordinate time as the independent variable. This perturbation solution, which is exact to fourth order in the interaction constant $\lambda = 2e^3H/3m^2c^4$, is compared with other solutions. (auth)

24536 PERTURBATIVE CALCULATIONS IN A UNIFIED GAUGE-FIELD MODEL OF STRONG, WEAK, AND ELECTROMAGNETIC INTERACTIONS. de Wit, B.; Pi, S.Y.; Smith, J. (Institute for Theoretical Physics, State University of New York at Stony Brook, Stony Brook, New York 11790). Phys. Rev. D 10: No. 12, 4278-4296 (15 Dec 1974).

We calculate several corrections to zeroth-order symmetry relations in a unified gauge-field model of strong, weak, and electromagnetic interactions. Among the topics discussed are the proton-neutron mass difference, the pion mass, the pion mass difference, and parity-violation effects. We discuss the perturbation scheme and establish the gauge invariance of the results. The pion mass originates from electromagnetic corrections and we find the value of 37 MeV. The pion mass difference is not affected by the inclusion of weak interactions and the hard-pion corrections to the mass difference are approximately 0.5 MeV. (auth)

24537 DYNAMICAL SYMMETRY BREAKING OF NON-ABELIAN GAUGE SYMMETRIES. Eichten, E.J. (Theory Group, Stanford Linear Accelerator Center, Stanford, California 94305); Feinberg, F.L. Phys. Rev. D 10: No. 10, 3254-3279 (15 Nov 1974).

We use the Schwinger mechanism to generate a dynamical breakdown of non-Abelian gauge symmetries. Such a breakdown is implemented by using bound-state Goldstone bosons which violate the global invariance associated with the gauge group. The usefulness of this realization of the Schwinger mechanism is that it eliminates the necessity of introducing elementary scalar particles, and, furthermore, it is a viable possibility in a pure Yang-Mills theory. Fermion and vector-meson mass relations in the pole approximation are discussed and compared with the zeroth-order mass relations in the familiar Higgs models. In addition, we obtain consistent solutions to the Bethe-Salpeter equation for the bound state in the weak-coupling limit, which yield finite vector-boson masses in the pole approximation. However, there are group-theoretical constraints which limit the possible groups and representations. (auth)

24538 DYNAMICAL SYMMETRY BREAKING IN ASYMPTOTICALLY FREE FIELD THEORIES. Gross, D.J.; Neveu, A. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 10, 3235-3253 (15 Nov 1974).

Two-dimensional massless fermion field theories with quartic interactions are analyzed. These models are asymptotically free. The models are expanded in powers of 1/N, where N is the number of components of the fermion field. In such an expansion one can explicitly sum to all orders in the coupling constants. It is found that dynamical symmetry breaking occurs in these models for any value of the coupling constant. The resulting theories produce a fermion mass dynamically, in addition to a scalar bound state and, if the broken symmetry is continuous, a Goldstone boson. The resulting theories contain no adjustable parameters. The search for symmetry breaking is performed using functional techniques, the new feature here being that a composite field, say, $\bar{\psi}\psi$, develops a nonvanishing vacuum expectation value. The "potential" of composite fields is discussed and constructed. General results are derived for arbitrary theories in which all masses are generated dynamically. It is proved that in asymptotically free theories the dynamical masses must depend on the coupling constants in a nonanalytic fashion, vanishing exponentially when these vanish. It is argued that infrared-stable theories, such as massless-fermion quantum electrodynamics, cannot produce masses dynamically. Four-dimensional scalar field theories with quartic interactions are analyzed in the large-N limit and are shown to yield unphysical results. The models are extended to include gauge fields. It is then found that the gauge vector mesons acquire a mass through a dynamical Higgs mechanism. The higher-order corrections, of order 1/N, to the models are analyzed. Essential singularities, of the Borel-summable type, are discovered at zero coupling constant. The origin of the singularities is the ultraviolet behavior of the theory. (auth)

24539 BOUND STATES AND ASYMPTOTIC SCALING LAWS IN FIELD THEORY. Appelquist, T.; Poggio, E. (Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02138). Phys. Rev. D 10: No. 10, 3280-3292 (15 Nov 1974).

We examine some of the problems associated with understanding wide-angle scaling laws in quantum field theory. We have in mind a model in which the hadrons are bound states of quarks. In this paper we examine elastic electromagnetic form factor behavior in a renormalizable scalar-field-theory model. We investigate the extent to which the asymptotic behavior is determined by the short-distance properties of the theory. The dependence on both the bound-state wave function and the strong radiative corrections is considered. The differences between the scalar theory and a more realistic quark-vector-gluon model are pointed out. (auth)

24540 NORMAL-PRODUCT QUANTIZATION OF CURRENTS AND RENORMALIZED WARD-TAKAHASHI IDENTITIES. Yoshida, K. (Institute of Physics, University of Salerno, Via Vernieri 42, Salerno, Italy). Phys. Rev. D 10: No. 10, 3293-3302 (15 Nov 1974).

We discuss the renormalizable σ model as the realization of Gell-Mann's current algebra. The Green's functions involving many currents are defined using the normal-product technique developed by Zimmermann and Lowenstein. The explicit definition of the so-called covariant T product (T^*) is given and reveals the "gauge-invariant" structure. This is compared with the renormalization of the corresponding gauge-field theory, and it is shown that the σ model with currents acts like a classical approximation to the Higgs model. (auth)

24541 GHOST-FIELD FORMALISM FOR VECTOR PARTICLES. Barua, D.; Gupta, S. N. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev., D; 10: 3303-3306(15 Nov 1974).

The quantization of vector fields with the use of an indefinite metric is examined. It is shown that a transformation of vector-field couplings in such a formalism will in general preserve the unitarity of the scattering operator for physical processes. Moreover, explicit calculations for a specific process seem to indicate that the coupling transformation does not affect even the renormalization constants. (auth)

24542 HIGGS MODEL WITH GHOST-FIELD FORMALISM. Barua, D.; Gupta, S.N. (Department of Physics, Wayne State University, Detroit, Michigan 48202). Phys. Rev. D 10: No. 10, 3306-3311 (15 Nov 1974).

The Higgs model for the interaction of vector and scalar fields is treated by means of the ghost-field formalism, which preserves the unitarity of the scattering operator as well as simplifies the renormalization procedure. Our ghost-field formalism has some similarity to the R_ξ formalism with $\xi = 1$, but it does not require the introduction of the so-called gauge-compensating terms. Applications to the second-order self-energy of a scalar particle and to the fourth-order scattering of vector particles are discussed. (auth)

24543 INFRARED BOOTSTRAP FOR THE ELECTRON MASS IN FINITE QUANTUM ELECTRODYNAMICS. Mannheim, P.D. (Institute for Advanced Study, Princeton, New Jersey 08540). Phys. Rev. D 10: No. 10, 3311-3317 (15 Nov 1974).

This paper is concerned with the infrared structure of Johnson-Baker-Willey finite quantum electrodynamics. In this theory the insertion of $\bar{\psi}\psi$, the composite mass operator, into the electron propagator satisfies a homogeneous Bethe-Salpeter equation whose solution is conformally invariant at short distances with an anomalous dimension, $\gamma_{\bar{\psi}\psi}(\alpha)$. To determine whether the theory is forced to actually choose a nontrivial solution to this homogeneous equation, we calculate the effective potential, $V(\langle\bar{\psi}\psi\rangle)$, using the dressed scalar vertex

as input. We find that the infrared divergences of the theory cause the effective potential to develop a degenerate minimum away from the origin in classical field space. Thus dynamical γ_5 symmetry breaking takes place with the electron acquiring a mass $m \sim \langle\bar{\psi}\psi\rangle$. It is thought that this may be a general mechanism for generating masses in an otherwise conformal–invariant theory. (auth)

24544 EFFECTIVE POTENTIAL FOR THE O(N) MODEL TO ORDER 1/N. Root, R.G. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 10: No. 10, 3322-3334 (15 Nov 1974).

The effective potential of the O(N) model is calculated to the next–to–leading order in the 1/N expansion in one, two, three, and four space–time dimensions. In one and two dimensions the vacuum is symmetric, as expected. In three dimensions the radiative corrections of order 1/N do not affect the position of the minimum of the effective potential. In four dimensions, the contribution to the effective potential of order 1/N is complex everywhere, suggesting that the 1/N expansion fails. (auth)

24545 ONE-LOOP DIVERGENCES OF THE EINSTEIN-YANG-MILLS SYSTEM. Deser, S.; Tsao, H. S.; van Nieuwenhuizen, P. (Department of Physics, Brandeis University, Waltham, Massachusetts 02154). Phys. Rev., D; 10: No. 10, 3337-3342(15 Nov 1974).

The one-loop ultraviolet divergences of the quantized coupled Einstein-Yang-Mills fields are evaluated. They are precisely of the same nonrenormalizable form as for a corresponding set of free Maxwell fields together with the usual flat-space Yang-Mills divergences. The two free Yang-Mills field parameters, namely the group dimension and the self-coupling constant, cannot be chosen to make the one-loop divergences renormalizable in the usual sense. (auth)

24546 POINCARÉ INVARIANCE OF THE SPIN–3/2 FIELD IN THE PRESENCE OF A MINIMAL EXTERNAL ELECTROMAGNETIC INTERACTION. Mainland, G.B. (Dublin Institute for Advanced Studies, Dublin 4, Ireland); Sudarshan, E.C.G. Phys. Rev. D 10: No. 10, 3343-3349 (15 Nov 1974).

Using the action principle, we determine the Poincaré transformation properties of second–quantized fields in the presence of external fields. We then construct expressions for the generators of the Poincaré group and explicitly verify that a second–quanized spin–3/2 field interacting with a minimal external electromagnetic field transforms covariantly. We thus conclude that the negative metric which appears in the quantization of the spin–3/2 field is not the result of a noncovariant quantization as has been claimed. (auth)

24547 GAUGE FIELDS ON A LATTICE: I. GENERAL OUTLOOK. Balian, R.; Drouffe, J.M.; Itzykson, C. (Service de Physique Théorique, Centre d'Etudes Nucléaires de Saclay, B.P. no. 2, 91190 Gif–sur–Yvette, France). Phys. Rev. D 10: No. 10, 3376-3395 (15 Nov 1974).

We present Wilson's model of gauge–field theory on a lattice, including a coupling to a matter field. The algebraic structure is surveyed for both commutative and noncommutative groups. Various regimes are suggested by mean–field theory according to the relative values of coupling constants. In particular, the gauge field undergoes a first–order transition, while the matter–field transition is of second order. (auth)

24548 GENERALIZATION OF THE PCT THEOREM TO ALL DISCRETE SPACE–TIME SYMMETRIES IN QUANTUM FIELD THEORIES. Santilli, R.M.; Ktorides, C.N. (Department of Physics, Boston University, Boston, Massachusetts 02215). Phys. Rev. D 10: No. 10, 3396-3406 (15 Nov 1974).

The methodology of the PCT theorem is applied to all discrete space–time symmetries in the framework of the Wightman formalism. New conditions which hold at Jost points only are introduced, and their significance is pointed out. A general theorem is proven according to which, in a field theory satisfying the Wightman axioms, with the possible exception of local commutativity, if any discrete space–time symmetry holds at all points, then there is a corresponding condition which holds at Jost points and vice versa. Possible links among various symmetries are investigated and two corollaries of the above theorem are formulated. Finally, some applications to both symmetry–preserving and symmetry–violating theories are discussed. (auth)

24549 CAN THE S MATRIX BE DEFINED IN RELATIVISTIC QUANTUM FIELD THEORIES WITH NONLOCAL INTERACTION?. Marnelius, R. (Institute of Theoretical Physics, Fack, S–402 20 Göteborg 5, Sweden). Phys. Rev. D 10: No. 10, 3411-3430 (15 Nov 1974).

Relativistic field theories with nonlocal interaction are investigated. This is essentially done in terms of the action principle with a generalized variation method previously developed by the author. That a classical theory of the above type has a canonical structure, at least for the perturbative solutions in terms of the asymptotic free fields, was once shown by Pauli. The in and out fields, for example, are equally good choices of canonical variables. A fundamental quantization in the Heisenberg picture is, therefore, Yang–Feldman–Källén quantization method. However, since the interacting fields never can be canonical variables, owing to the nonlocality in time, the classical expressions of the Poincaré generators (properly symmetrized) are no longer conserved and have no longer the right generator properties in the quantum case for any nonlinear model. There exist, however, new generators which are conserved and which have the right generator properties. These generators may be derived from the action principle by means of q–number variations instead of c–number variations. However, these generators are not uniquely determined. In particular, it is shown that any nonlinear model has an in and an out representation of the generators which are different in terms of the interacting fields. They can, therefore, only be equal because of some particular property of the field equations. Explicit calculations are performed for a particular model due to Kristensen and Møller (a nonlocalized Yukawa coupling). For this model it is shown that the in and out representations indeed are different (in the fourth order in the coupling constant), even for the charge–symmetric version of the model. (The properties under the discrete transformations C, P, and T are also considered.) This implies that the field equations do not yield unique quantum solutions and, in particular, that the solutions with canonical incoming free fields are different from the solutions with canonical outgoing free fields, and none of these solutions render the total action stationary. No meaningful S matrix can therefore be defined. It is also shown that this deficiency cannot be corrected either by restricting the form function or by adding correction terms to the perturbation theory. (auth)

24550 COMMENT ON "NEW APPROACH TO THE RENORMALIZATION GROUP". Gomes, M. (Instituto de Física, U.S.P., São Paulo, Brasil); Schroer, B. Phys. Rev. D 10: No. 10, 3525-3531 (15 Nov 1974).

Following previous discussions concerning the field–theoretical derivation of Kadanoff's scaling laws, we apply the method of "soft quantization" to the derivation of a homogeneous renormalization–group equation. This equation is similar to the one proposed recently by S. Weinberg. In addition to our attempt to close the "communication gap" between physicists working on critical phenomena and high–energy physics, we discuss some new applications of such homogeneous differential equations to perturbations of scale–invariant models. (auth)

24551 CONFORMAL WARD IDENTITY IN THE σ MODEL. Ahmed, M.A. (Physics Department, University of Khartoum, Khartoum, Sudan). Phys. Rev. D 10: No. 10, 3532-3536 (15 Nov 1974).

The conformal Ward identity in the σ model is derived using normal-product methods. (auth)

24552 THE ABSTRACT HILBERT SPACE GENERALIZATION OF FEENBERG'S PERTURBATION THEORY–A NEW METHOD OF QUANTUM FIELD THEORY. Bowen, S.P. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). J. Math. Phys. (N.Y.) 16: No. 3, 620-632 (Mar 1975).

A rigorous generalization of Feenberg's perturbation theory to the calculation of thermodynamic Green's functions is outlined. This method offers an algorithm for calculating correlation functions and propagators for any Hamiltonian, bounded or unbounded, and is exact and tractable in the thermodynamic limit. The method is defined and its use is illustrated by several brief examples. (auth)

24553 A MODEL OF QUANTUM FIELD THEORY TREATED IN THE FOCK–COOK FORMALISM. II. Schroeck, F.E. Jr. (Department of Mathematics, Florida Atlantic University, Boca Raton, Florida 33432). J. Math. Phys. (N.Y.) 16: No. 3, 729-739 (Mar 1975).

The Fock–Cook formalism for quantum field theory is further generalized, and the methods developed are used to remove all cutoffs from a variety of Yukawa–type interactions in one and two space dimensions. We conclude that the usual operator–valued distribution approach to quantum field theory is not always necessary. (auth)

24554 PARTICLE SPECTRUM IN QUANTUM FIELD THEORY. Polyakov, A. M. (L. D. Landau Institute of Theoretical Physics). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 194-195(20 Sep 1974).

It is shown that particles with anomalously large mass, called extremons, exist in three-dimensional models in quantum field theory. The solution to the equation for the extremal is investigated in the theory of Higgs' isovector field. (LBS)

24555 ON THE EQUIVALENCE OF THE EUCLIDEAN AND WIGHTMAN FORMULATION OF FIELD THEORY. Glaser, V. (European Organization for Nuclear Research, Geneva (Switzerland)). Commun. Math. Phys.; 37: No. 4, 257-272(Sep 1974).

A mistake in the paper on the "Axioms for Euclidean Green's Functions" by Osterwalder und Schrader (Comm. Math. Phys. 31,83(1973)) is corrected in the following sense: thanks to these axioms the Euclidean Schwinger functions S_n can be analytically continued to the corresponding Wightman functions W_n possessing all the correct analyticity properties and satisfying a generalized

positivity condition in the complex domain. It is, however, suggested by the proof that their tempered behavior near the Minkowski points cannot be guaranteed without additional assumptions. (GE)

24556 RELATIVE VELOCITY MEASUREMENTS OF ELECTRONS AND GAMMA RAYS AT 15 GeV. Guiragossián, Z.G.T.; Rothbart, G.B.; Yearian, M.R. (Department of Physics and High Energy Physics Laboratory, Stanford University, Stanford, California 94305); Gearhart, R.A.; Murray, J.J. Phys. Rev. Lett. 34: No. 6, 335-338 (10 Feb 1975).

Measurements were made to detect differences in the velocity of propagation of γ rays and electrons in the energy range 15–20 GeV, by using a time-of-flight technique with 1-psec sensitivity and a flight path of ~ 1 km. A relative velocity difference larger than $1-\beta_e$ ($\sim 5\times10^{-10}$) would imply a breakdown of special relativity. No significant difference in the velocities of light and electrons was observed to within ~2 parts in 10^7. (auth)

24557 THEORY OF MAGNETIC MONOPOLES WITH NON-ABELIAN GAUGE SYMMETRY. Christ, N.H. (Department of Physics, Columbia University, New York 10027). Phys. Rev. Lett. 34: No. 6, 355-358 (10 Feb 1975).

A generalization of the non-Abelian gauge theory of Yang and Mills is presented in which the field strengths $F_{\mu\nu}{}^i$ and their duals $\tilde{F}_{\mu\nu}{}^i$ enter symmetrically. The theory is symmetrical under a noncompact gauge group and permits the introduction of both electric and magnetic sources. (auth)

24558 VECTOR-TENSOR FIELD THEORIES AND THE EINSTEIN-MAXWELL FIELD EQUATIONS. Lovelock, D. (Univ. of Waterloo, Ont.). Proc. Roy. Soc. (London), Ser. A; 341: No. 1626, 285-297(10 Dec 1974).

The Euler-Lagrange equations corresponding to a Lagrange density which is a function of the metric tensor g_{ij} and its first two derivatives together with the first derivative of a vector field Ψ_i are investigated. In general, the Euler-Lagrange equations obtained by variation of g_{ij} are of fourth order in g_{ij} and third order in Ψ_i. It is shown that in a four dimensional space the only Euler-Lagrange equations which are of second order in g_{ij} and first order in Ψ_i are the Einstein field equations (with an energy-momentum term). Various conditions are obtained under which the Einstein-Maxwell field equations are then an inevitable consequence. (auth)

24559 QUANTUM STATISTICAL PROPERTIES OF RADIATION. Louisell, W. H. Pure and Applied Optics. New York; John Wiley and Sons, Inc. (1973). 540p.

The topics covers are the Dirac formulation of quantum mechanics, elementary quantum systems, operator algebra, boson creation and annihilation operators, quantization of the electromagnetic field, the interaction of radiation with matter, quantum theory of damping-density operator methods and the Langevin approach, the Lamb semiclassical theory of a laser, and statistical properties of a laser. (JFP)

Gravitation and General Relativity

Refer also to abstracts 23571, 23774, 23777, 23988, 24007, 24508, 24545, and 24558.

24560 (CONF-730660-P1, pp A137-A146) PROJECTIVE REPRESENTATIONS OF THE ASYMPTOTIC SYMMETRY GROUP OF GENERAL RELATIVITY. McCarthy, P. J. (Univ. of British Columbia, Vancouver). Sep 1973.

From 2nd international colloquium on group theoretical methods in physics; Nijmegen, Netherlands (25 Jun 1973).

In proceedings of the 2nd international colloquium on group theoretical methods in physics.

Some criticisms are made of Wigner's classification of specially relativistic quantum systems — in particular of elementary relativistic systems — are made. It is suggested that the Poincare group should be replaced by the asymptotic symmetry group of general relativity in a quantum theory which takes gravity into account. The structure of this "B.M.S." group is described, and the unitary induced representations constructed under the assumption that the group carries the "Cantoni topology." Possible advantages over the Poincare scheme are pointed out. Some recent work on lifting of projective representations is reported. The effect on the results of choosing another topology for the group is discussed, and compared to similar situations in other branches of physics. (auth)

24561 QUANTUM GRAVIDYNAMICS. I. Path Integrals in Curved Space-Time. Clutton-Brock, M. (Newcastle upon Tyne Univ., Eng.). J. Phys., A (London); 8: No. 1, 16-28(Jan 1975).

The aim is to develop in as simple and elementary a fashion as possible the quantum dynamics of gravitating particles in a strongly curved classical background geometry. This type of theory is important when the radius of curvature of the universe is less than the Compton wavelength of the particles. Path integrals provide the simplest entry to quantum gravidynamics, and path integrals without spin are considered. Path integrals are convolutions of kernels for many small intervals: the curved space kernel for a small interval is found by suitably generalizing the free-particle flat space kernel. The structure of a relativistic path integral is very different from that of a nonrelativistic path integral, and is illustrated by describing how to evaluate a path integral — at least in principle — by a crude Monte Carlo method. Path integrals for several particles involve an action principle, which is expressed in terms of particle paths using an integral formulation of Mach's principle. When particles approach to within their gravitational radius, path integrals and even the space-time continuum become meaningless. (auth)

24562 BIRKOFF'S THEOREM AND EQUATIONS OF MOTION IN A UNIFIED FIELD THEORY. Dunn, K. A. Toronto; Univ. of Toronto (1973). 87p.

Thesis.

A model for a unified field theory of electromagnetism and gravitation is considered in a modified Riemannian geometry, first introduced by Lyra in 1951. An intrinsic derivation of the geometry is given by defining a Lyra connection. A comparison is made with Weyl's theory and it is seen that Lyra geometry does not suffer from the physical defects of Weyl's theory. Using Killing vectors, the form of the spherically symmetric metric is obtained and the field equations, derived from a variation principle, are solved for a static spherically symmetric charged mass distribution. The solution obtained is compared with that of Reissner-Nördstrom and found to have a similar physical interpretation. A proof of Birkhoff's theorem is given, making certain natural assumptions concerning the electromagnetic field, and it is shown that in this case a coordinate system exists in which both the electromagnetic and gravitational fields are static. Using the method of Einstein, Infeld and Hoffmann, the Newtonian approximation to the equations of motion of N particles is obtained from the field equations. A study is made of these equations as well as a discussion of the possible choice of the trajectory of a test particle. (auth)

24563 THEORY OF DYNAMICAL AFFINE AND CONFORMAL SYMMETRIES AS THE THEORY OF THE GRAVITATIONAL FIELD. Borisov, A. B.; Ogievetskii, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 22: No. 3, 329-342(Dec 1974). (In Russian).

Invariance with respect to infinite-parameter group of general covariance is equivalent to the joined invariance with respect to affine and conformal groups simultaneously Nonlinear realization of affine group (with linearization on the Poincare group) leads to a symmetric tensor field as the Goldstone field. Requirement that the theory would correspond at the same time to the realization of the conformal group, leads in an unique way to the theory of the tensor field with the equations coinciding with the Einstein equations. Thus it is shown that the theory of gravitational field is in fact the theory of spontaneous breaking of the affine and conformal symmetries, just as chiral dynamics is the theory of spontaneous breaking of chiral symmetry. The analogy found makes it possible to reveal new aspects of the role of gravitation in the elementary particle theory. (auth)

24564 U(3) VERSION OF THE f-g THEORY. Isham, C.J.; Tucker, M.C. (Department of Mathematics, King's College, London W.C. 2, England). Phys. Rev. D 10: No. 10, 3219-3225 (15 Nov 1974).

A U(3) -invariant generalization of the f-g theory of the strong and gravitational interactions is given. An invariant Lagrangian is formulated, which is shown to describe a U(3) nonet of spin-2 fields, and a procedure is presented whereby the fields acquire masses through interaction with the gravitational field. Invariant interactions of the spin-2 fields with matter fields of spin 0, 1, and 1/2 are also constructed, using for the last of these a generalization of the vierbein and spin connection formalism of general relativity. Finally, the full equations of motion for the spin-2 fields are derived. (auth)

24565 QUANTIZATION OF A COUPLED FERMI FIELD AND ROBERTSON-WALKER METRIC. Isham, C.J.; Nelson, J.E. (Department of Mathematics, King's College London, London, England). Phys. Rev. D 10: No. 10, 3226-3234 (15 Nov 1974).

The combined Dirac field and Robertson-Walker metric system is quantized in a Heisenberg picture. One of the Einstein equations is implemented as a constraint on the state vectors and leads to a spectrum for the allowed values of the mass of the spinor field. (auth)

24566 THE CAUCHY PROBLEM IN GENERAL RELATIVITY. I. METRICS CONTAINING ARBITRARY FUNCTIONS. d'Inverno, R.A. (Department of Mathematics, University of Southampton,

Southampton S09 5NH, England). J. Math. Phys. (N.Y.) 16: No. 3, 670-673 (Mar 1975).

This paper develops a Lagrangian formalism (the y_4—formalism) for use in investigating the Cauchy problem in general relativity. In particular it will be used in a subsequent paper to present a Lagrangian formulation of the characteristic initial—value problem in general relativity. The formalism enables one to define "field equations" and "Bianchi identities" for metrics containing arbitrary functions in the case when the arbitrary functions are treated as the field variables. (auth)

24567 THE CAUCHY PROBLEM IN GENERAL RELATIVITY. II. MAIN AND CONSTRAINT EQUATIONS IN THE CHARACTERISTIC INITIAL—VALUE PROBLEM. d'Inverno, R.A. (Department of Mathematics, University of Southampton, Southampton S09 5NH, England). J. Math. Phys. (N.Y.) 16: No. 3, 674-678 (Mar 1975).

This paper applies the "y_4—formalism" of a previous paper (Paper I) to a Lagrangian formulation of the characteristic initial—value problem in general relativity. The essential content of the paper is the respective identifications of the "field equations" and "Bianchi identities" of the y_4—formalism with the "main equations" and "constraint equations" of a metric in a Bondi coordinate system. The identifications are developed in detail in the case of Bondi's (axially symmetric) radiating metric. (auth)

24568 STATIC ELECTROVACUUM SPACETIMES WITH BIFURCATE HORIZONS. Hájiček, P. (Institute for Theoretical Physics, University of Berne, Berne, Switzerland). J. Math. Phys. (N.Y.) 16: No. 3, 523-527 (Mar 1975).

We prove a necessary and sufficient condition for a stationary electrovacuum spacetime with a bifurcate horizon to be static. The condition is expressed by means of the invariant quantities introduced in the preceding paper. (auth)

24569 STATIONARY ELECTROVACUUM SPACETIMES WITH BIFURCATE HORIZONS. Hájiček, P. (Institute for Theoretical Physics, University of Berne, Berne, Switzerland). J. Math. Phys. (N.Y.) 16: No. 3, 518-522 (Mar 1975).

General features of all stationary electrovacuum solutions of Einstein—Maxwell equations which contain regular bifurcate horizons are studied. A certain set of invariant quantities is found in whose values the full information about the solutions is recorded. The quantities have a simple physical meaning and generalize directly the "local invariants" defined for the axially symmetric case in the previous paper [J. Math. Phys. 15, 1554 (1974)]. A necessary condition that the solutions represent a neighborhood of a black hole in an asymptotically flat spacetime is given. The condition has the form of an inequality which places an upper bound on the magnitudes of the gravimagnetic, electric, and magnetic fields at the horizon. In the case of axial symmetry, the inequality reduces to that derived in the previous paper. (auth)

24570 STATIC CYLINDRICALLY SYMMETRIC SOLUTIONS OF THE EINSTEIN—MAXWELL EQUATIONS. Chitre, D.M. (Department of Physics, University of California, Santa Barbara, California); Güven, R.; Nutku, Y. J. Math. Phys. (N.Y.) 16: No. 3, 475-477 (Mar 1975).

A general class of solutions of Einstein—Maxwell equations with static cylindrical symmetry is obtained. The equations are derived using canonical methods, and the fields are shown to satisfy a certain Painlevé differential equation of the third transcendental type. A particular algebraic solution is studied in detail, and is found to have a certain mass and current on the axis and a helical magnetic field around it. (auth)

24571 BOUNDARIES OF SPACETIMES. Duncan, D.P. (Bell Laboratories, Murray Hill, New Jersey 07974); Shepley, L.C. J. Math. Phys. (N.Y.) 16: No. 3, 485-492 (Mar 1975).

A review of the Schmidt technique and the Sachs technique for assigning boundary points to spacetimes is given. A modification of the Sachs process which makes it obviously identical with Schmidt's is suggested. Some simple examples are discussed. (auth)

24572 SPACETIME SYMMETRIES AND LINEARIZATION STABILITY OF THE EINSTEIN EQUATIONS. I. Moncrief, V. (Department of Physics, University of Utah, Salt Lake City, Utah 84112). J. Math. Phys. (N.Y.) 16: No. 3, 493-498 (Mar 1975).

We consider the Marsden—Fischer conditions for linearization stability applied to vacuum spacetimes with compact Cauchy hypersurfaces. We show that, if a vacuum spacetime S admits a Killing vector field, then the Marsden—Fischer criterion fails to be satisfied at any Cauchy surface for S. We also show that, if the Marsden—Fischer criterion fails to hold on an initial surface, then there is a Cauchy development of those initial data which admits one or more Killing vectors. The number of independent Killing fields present is shown to equal the dimension of the kernel of the linear map defined by Marsden and Fischer. (auth)

24573 GRAVITATIONAL PERTURBATIONS OF SPHERICALLY SYMMETRIC SYSTEMS. I. The Exterior Problem. Moncrief, V. (Department of Mathematics, University of California at Berkeley, California 94720). Ann. Phys. (N. Y.); No. 2, 323-342 (Dec 1974).

Gravitational perturbations of the Schwarzschild metric are treated from a point of view which is adapted, in a natural way, to the gauge group of the perturbed Einstein equations. The metric perturbations are explicitly decomposed into their gauge invariant, gauge dependent, and constrained parts and a variational principle for the perturbation equations is derived. The Regge—Wheeler and Zerilli equations are rederived and shown to have a gauge invariant significance. The Hamiltonian for the perturbations is constructed and used to discuss the stability properties of the Schwarzschild black hole. (auth)

24574 CHANGE OF PETROV TYPE UNDER GENERATION OF SOLUTIONS OF EINSTEIN'S EQUATIONS. Sneddon, G.E. (Department of Mathematics, Monash University, Clayton, Vic 3168, Australia). J. Math. Phys. (N.Y.) 16: No. 3, 740-742 (Mar 1975).

A method given by Geroch [J. Math. Phys. 12, 918 (1971)] for generating new solutions of the vacuum gravitational field equations from known solutions is investigated in order to find out how the Petrov type of the new metric will be related to that of the old metric. Conditions are found under which algebraically special metrics will generate algebraically special metrics. It is shown how the Petrov type of these metrics will change under the generation method of Geroch. (auth)

24575 SECOND QUANTIZATION IN THE KERR METRIC. Unruh, W.G. (Department of Physics, University of California, Berkeley, Berkeley, California 94720). Phys. Rev. D 10: No. 10, 3194-3205 (15 Nov 1974).

The second quantization of scalar and neutrino fields in the Kerr metric is discussed, and an instability to spontaneous emission is found in the scalar and neutrino cases. The dependence of these results on assumptions about the vacuum state is discussed as is the semiclassical origin of this creation. (auth)

24576 AXIALLY SYMMETRIC TWO—BODY PROBLEM IN GENERAL RELATIVITY. Cooperstock, F.I. (Laboratoire de Physique Théorique, Institut Henri Poincaré, 11, rue Pierre et Marie Curie, 75231 Paris Cedex 05, France). Phys. Rev. D 10: No. 10, 3171-3180 (15 Nov 1974).

The advantages of the analysis of the two—body problem from an initially static configuration are discussed. The stress which maintains the static equilibrium of two bodies is removed, and the complementary phenomena of stress breaking and mass motion lead to a dynamic metric perturbation and radiation. The distinctions between the stress—breaking and free—fall phases of the motion are clearly delineated. A new contribution to the radiated energy which arises from the time variation of the tidal forces across the sources in the course of free fall is developed. A potentially very significant contribution from the nonlinearities is also discussed. (auth)

24577 BEHAVIOR OF SPACELIKE GEODESICS IN THE EXTENDED SCHWARZSCHILD MANIFOLD. Honig, E. (Scarborough College and Department of Physics, University of Toronto, West Hill, Ontario, Canada); Lake, K.; Roeder, R.C. Phys. Rev. D 10: No. 10, 3155-3161 (15 Nov 1974).

We demonstrate that there exist unstable, spacelike, circular orbits in the Schwarzschild field for all radii in the range $0 < r < 3m$. The conditions under which spacelike trajectories bend toward or away from the source of the field are derived for the entire $r-\phi$ plane. We show that any nonradial spacelike geodesic with turning point less than $2m$ will appear spacelike over the entire $u-v$ plane. The scattering and capture cross sections for a particle on a spacelike trajectory are evaluated. Finally, we suggest that there are compelling reasons for rejecting the usual assumption of a global past—future relation in the extended Schwarzschild manifold. (auth)

24578 CONSERVED VECTORS OF THE KOMAR TYPE AND COMPATIBILITY IDENTITIES IN LAGRANGIAN FIELD THEORIES. Pavelle, R. (Perception Technology Corporation, Winchester, Massachusetts 01890). J. Math. Phys. (N.Y.) 16: No. 3, 696-702 (Mar 1975).

Given a Lagrangian which is an invariant density and a concomitant of a set of independent geometrical objects, it is shown that there is a unique conserved vector associated with the Lagrangian. For cases of interest the vector is constructed and is seen to be identical with Komar's conserved vector for general relativity. For a general Lagrangian we also construct the "compatability identity" relating the Euler—Lagrange tensors. The connection between these identities, the invariance identities of Rund, and Lie derivatives of invariant densities is found. (auth)

24579 A FAMILY OF JORDAN—BRANS—DICKE KERR SOLUTIONS. McIntosh, C. B. G. (Monash Univ., Clayton (Australia). Dept. of Mathematics). Commun. Math. Phys.; 37: No. 4, 335-341 (Sep 1974).

A family of solutions of the vacuum Jordan—Brans—Dicke or

scalar–tensor gravitational field equations is given. This family reduces to the Kerr rotating solution of the vacuum Einstein equations when the scalar field is constant. The family does not have spherical symmetry when the rotation is zero and the scalar field is not constant. The method used to generate the new solutions can also be used to obtain vacuum Jordan–Brans–Dicke solutions from any given vacuum stationary, axisymmetric solution. (auth)

REACTOR TECHNOLOGY AND REGULATION

24580 SCOPE OF THE INTERNATIONAL NUCLEAR INDUSTRY. Atomic Industrial Forum, 1972 International Conference, Washington, DC, November 12–16, 1972. Jones, C. F. Rockville, MD; NUS Corporation (1972). 108p. (CONF-721158-).

Separate abstracts were prepared for 6 of the 8 papers included. (JWR)

For abstracts of individual papers see: 24581, 24582, 24953, 25071, 25072, and 25077.

24581 NUCLEAR PLANT INDUSTRY. Jones, C. F. pp 54-65 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

A historical review of the nuclear power plant industry is presented. Some of the problems, successes, and failures of the industry are described and the current status of the industry is discussed. (JWR)

24582 RESOURCE DEMAND OF NUCLEAR POWER. Campbell, K. H. pp 88-100 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

Questions concerning resources necessary to fulfill forecasts of nuclear power growth are examined. Topics discussed include capital requirements, fuel cycle requirements, and technology and manpower requirements. (JWR)

24583 NUCLEAR ENERGY IN ASIA. Casa, A. F.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 20: No. 10, 41-85(Oct 1974). (In Italian).

A picture of the major nuclear activities now under way in the various Asian countries is presented. The following Asian countries are dealt with: Afghanistan, Saudi Arabia, Bangladesh, Ceylon, National China, Red China, South Korea, Philippines, Japan, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Lebanon, Malaysia, Pakistan, Singapore, Thailand, Turkey, Soviet Union, South Vietnam. 137 references. (auth)

24584 THE CHEMICAL OPERATION OF WATER-VAPOR COOLING CIRCUITS. Bursik, A. Energie; 26: No. 9, 276-277(Sep 1974). (In German).

Some of the most important and suitable chemical kinds of operation used in conventional and nuclear power plants and problems concerned with them are treated. (GE)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 22549, 24674, 24929, 24938, 24940, 24942, 24955, 24956, 24968, 24970, 24971, 24985, 25039, 25080, 25082, and 25097.

24585 (IRS-T-21, pp 75-93) COMPARATIVE CALCULATIONS OF EXPERTS WITHIN THE FRAMEWORK OF PRELIMINARY CONTROLS CONCERNING THE DESIGN OF THE REACTOR PRESSURE VESSEL PHILIPPSBURG I. Elter, C.; Reynen, J.; Waldner, K. Mar 1974. (In German).

From VdTUeV/IRS–colloquium; Koeln, F. R. Germany (20 Mar 1973).

In finite-element method in the evaluation of structural components.

The purpose of the comparative calculations was to have the calculations for the pressure vessel of the BWR Philippsburg I presented by the manufacturer of the vessel checked by various experts of different institutions. These preliminary controls have been done on a selection of appropriate parts of the reactor pressure vessel, and for several stress conditions. The present contribution discusses the use of a finite element program developed by CEGB in England, which has been supplemented by the Euratom programs for mesh calculations also for various vessel nozzle geometries. (GE)

24586 (NDS-21) PLANNING STUDY FOR WATER REACTOR SUPPORT SYSTEMS BUSINESS. Marquis, M. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 82p. Dep. NTIS $7.25.

A market analysis for light water reactor support systems business is presented. These support systems include fuel handling, waste management, and radioactive maintenance. (JWR)

24587 (NEDO-20360(Rev.1)(Suppl.1)) GENERAL ELECTRIC BOILING WATER REACTOR GENERIC RELOAD APPLICATION FOR 8 × 8 FUEL. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). 11 Dec 1974. vp.

Revised information is presented on the mechanical design and the safety analysis of 8 × 8 fuel assemblies. (JWR)

24588 (NP-tr-1953) STEAM PRESSURE SYSTEMS. Main Primary Circuit of Boiling-Water Reactor. 1. Decision of February 26, 1974 Applying Regulations on Pressure Systems to Boiling-Water Reactors. 2. Circular of February 26, 1974 on the Application of Regulations for Steam Pressure Systems to the Main Primary Circuit of Boiling-Water Reactors. Sep 1974. Translated from Journal Officiel No. 74-63, Supplement No. 1 to Brochure No. 1331. 68p.

Regulations are presented for the fabrication, testing, installation, use, maintenance, and monitoring of steam generators for BWR type reactors. (JWR)

24589 CALCULATED EFFECT OF RADIALLY ASYMMETRIC HEAT GENERATION ON TEMPERATURE AND HEAT FLUX DISTRIBUTION IN A FUEL ROD. Harayama, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nucl. Eng. Des.; 31: No. 1, 66-71(Nov 1974).

The effect of radially asymmetric heat generation on the temperature and heat flux distribution in a fuel rod is evaluated. Based on practical assumptions, the temperature distribution in power reactor fuel can be obtained between reasonable limits by solving the steady-state heat conduction equation with asymmetric heat generation. (auth)

24590 REFINED CRACKED CONCRETE ANALYSIS OF CONCRETE CONTAINMENT STRUCTURES SUBJECT TO OPERATIONAL AND ENVIRONMENTAL LOADINGS. McGeorge, R.; Swec, L. F. Jr. (EDS Nuclear Inc., San Francisco, California 94104, USA). Nucl. Eng. Des.; 29: No. 1, 58-70(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Recent commercial nuclear power plant containment concepts involve the use of large reinforced concrete structures to form pressure boundaries. Where these structures are not provided with an integral steel liner, excessive cracking of the concrete under loads could result in the loss of the pressure boundary integrity with the risk of over-pressurization of other structures. Cracking of concrete is a local phenomenon and considerable detail must be included in any analytical model to obtain sufficiently refined results for the prediction of crack size and propagation. This imposes severe limitations on the overall size of structures or structural components for which detailed cracking analysis can be considered directly. To overcome this restriction, a two step procedure was developed in which linear analyses were performed to obtain the gross response, and nonlinear cracking analyses were performed for selected portions of the structure to evaluate local cracking in detail. Through iteration, compatibility of behavior between the linear and nonlinear analyses was achieved with the gross response being used to extrapolate the local cracking results to predict cracking over the entire structure. Analyses performed for an actual unlined reinforced concrete containment structure using these procedures are discussed and results are presented. (auth)

24591 RESEARCH AND DEVELOPMENT TOWARDS A PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL FOR LIGHT-WATER REACTORS. Bremer, F.; Huber, G.; Bindseil, P. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Universalbau); Spandick, W. (Krupp (Friedr.) G.m.b.H., Essen (F. R. Germany). Forschungsinstitut). Nucl. Eng. Des.; 29: No. 1, 39-57(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The escalation of power unit output for nuclear power stations with light-water reactor has led to difficulties in manufacturing and to safety problems for thick-walled steel pressure vessels. The unit output was increased in the last ten years step by step from 300 to 600 and 1200 MW(e). Escalation to more than 2000 MW(e) can be expected. In light of this escalation of unit generation capacity the PCPV has an economic chance of being introduced for light water reactors. In 1968, Krupp began development of a PCPV for boiling-water reactors (BW Rs). In 1972, a refer-

ence design was completed. In 1973, work on a PCPV for light-water reactors was concentrated on a prototype design with particular reference to safety and economic aspects. The reference design finished in 1972 is presented. The main points covered are the overall design; the structural design of particular parts such as the liner and insulation, and the penetration tubes; structural analysis of the PCPV and liner; safety aspects; tests made with the liner, insulations, and concrete; and development potential of the PCPV for light-water reactors. (auth)

24592 AUXILIARY PUMPS FOR THE PRIMARY CIRCUIT OF THE 800 MW NUCLEAR POWER STATION CAORSO EIV OF ENEL, ITALY. Laux, C. H. Combustion; 46: No. 7, 28-37 (Jan 1975).

The auxiliary pumps for the safety system of a boiling-water reactor are feed pumps of a special type. The importance and duties of auxiliary pumps in this system together with their design features are described. (auth)

24593 DEVELOPMENT, CONSTRUCTION, AND OPERATION OF LIGHT-WATER-REACTOR-BASED ATOMIC POWER PLANTS IN THE GERMAN FEDERAL REPUBLIC. Hundt, D. Energ. Atomtech.; 26: No. 11, 508-516(1973). (In Hungarian).

More than 90% of the nuclear power plants in West Germany, including those under construction, are based on pressurized or boiling light-water reactors. After a period of working on the basis of American license agreements, the German firms AEG-Telefunken and Siemens became equal competitors for even the largest units. The first experimental 16 MW(e) Kahl–Main boiling-water plant, in operation since 1961, was followed by three 250-MW(e) demonstration units which were built with federal subsidy; the next two 650 MW(e) units did not receive any support. At present 9 plants with a total capacity of 10,500 MW(e) are under construction; by 1980 the nuclear plants will generate 20,000 to 22,000 MW(e) and 100,000 MW(e) by 1990, generating about 50% of the electric power of the country. The design of the AEG-Telefunken boiling water reactor is described with emphasis on the development of the axial circulating pumps responsible for the reliable, safe, and economical operation of the power plant. The loss-of-coolant accident is controlled by three redundant after-coolers which flood the core. In the pressurized water system developed by Siemens a boric acid solution is used in addition to mechanically actuated control rods to adjust the power level. All presently operating plants were built in less than 4 years in spite of procurement problems. At the end of 1971 the average availability of all power plants of the West German system was about 80%; that of the nuclear units 90%. (TTT)

24594 STEAM TURBINE POWER PLANT, MORE PARTICULARLY ATOMIC POWER STATION. Heller, L.; Forgo, L.; Bakay, A. (to Transelektro Magyar Villamossagi Kulkereskedelmi Vallalat). US Patent 3,851,474. 3 Dec 1974. Priority date 27 Oct 1971, Hungary. 4p.

Where the steam of such power plants is generated by atomic reactors such as boiling water reactors, the exhaust steam is radioactive and, therefore, must not directly contact the cooling water for reasons of ecology. The employment of surface condensers, on the other hand, in case of wet cooling towers is connected with a series of difficulties. In order to avoid this, it is suggested to employ a steam transformer upstream from the low pressure stage of the steam turbine of the power plant. Then, the radioactive steam withdrawing from the high pressure stage of the turbine is condensed on the primary side of the steam transformer while the heat freed by such condensation will generate steam on the other side of the steam transformer from a condensate coming from a condenser. Thus, the secondary steam will not be contaminated by radioactive substances and, therefore, the steam of the low pressure stage of the steam turbine may already be condensed in a mixing condenser. (Official Gazette)

24595 FUEL ASSEMBLY FOR NUCLEAR REACTOR. Kamo, Y. (to Hitachi, Ltd.). US Patent 3,856,623. 24 Dec 1974. Priority Date 6 Aug 1971, Japan. 4p.

A nuclear reactor fuel assembly is comprised of a plurality of fuel rods, two upper and lower tie plates for holding the fuel rods at their upper and lower ends, two mounting frames, each being fixed to the respective tie plate, and segment spacers between the mounting frames. By the engagement of the segment spacers with the mounting frames, complicated processing of the conventional connector fuel rods is eliminated, and the danger of damages due to thermal strain caused by welding is reduced through the use of fewer welded parts. (Official Gazette)

24596 BLOCKING ARRANGEMENT FOR MECHANISM FOR HANDLING FUEL ASSEMBLIES IN NUCLEAR REACTORS. Suvanto, A.; Fries, A. (to Aktiebolaget Asea-Atom). US Patent 3,856,621. 24 Nov 1974. Priority Date 21 Apr 1969, Sweden. 12p.

Fuel assemblies for nuclear reactors are positioned in a receiving member, from which they, as well as a control rod, can be lifted by a gripping device having two legs pivoted to each other. A stop arrangement is provided which prevents the gripping device from lowering the fuel assembly all the way into the receiving member unless it is properly oriented with respect thereto. (Official Gazette)

24597 HYDRAULIC PROBLEMS IN NUCLEAR FEEDPUMPS DEMAND ATTENTION TO CUT COSTLY DOWNTIME. Makay, E.; Ewers, B. Power (N. Y.); 119: No. 3, 21-25(Mar 1975).

Troubles developing in these important units are threatening plant availability in many cases. The basic causes and the choices available are described. (auth)

24598 PLUG TECHNOLOGY ADAPTED FOR REACTOR REPAIR. Elec. World; 138: No. 1, 38-40(1 Jan 1975).

The use of freeze plugs during maintenance and repair of BWR primary cooling system is described. (DCC)

24599 THE 380-kV SWITCHING STATION OF THE NUCLEAR POWER PLANT PHILIPPSBURG. Energiewirt. Tagesfragen; 24: No. 10, 494-495(Oct 1974). (In German).

The construction and concept of the 380 kV switching station of the nuclear power plant Philippsburg are described. In the designing of the station, safety considerations were the determining factor. It is shown that the switching station is constructed in such a manner that a loss of unit power is very unlikely. (GE)

24600 GROWING ACCEPTANCE FOR CONDENSATE POLISHING IN NUCLEAR CENTRAL STATIONS. Strauss, S. D. Power (N.Y.); 118: No. 11, 66-67(Nov 1974).

Water-chemistry problems in BWR and PWR power plants are described. The use of demineralizers and filters for condensate treatment is discussed. (DCC)

24601 NEW FLUID-HANDLING EQUIPMENT TRENDS INFLUENCE NUCLEAR COOLING, SOOTBLOWING. O'Keefe, W. Power (N.Y.); 118: No. 11, 56-60(Nov 1974).

The performance requirements for nuclear auxiliary pumps of BWR and PWR power plants and for air compressors of fossil-fuel power plants are discussed. (DCC)

24602 OPTIMIZATION OF REFUELING SCHEDULE FOR LIGHT-WATER REACTORS. Motoda, H.; Herczeg, J.; Sesonske, A. (Purdue Univ., West Lafayette, IN). Nucl. Technol.; 25: No. 3, 477-496(Mar 1975).

A stagewise optimization of the refueling schedule for light-water reactors has been developed with emphasis on the nuclear model. The decision variables to be determined are end-of-cycle (EOC) reactivity distribution, energy output, power distribution, number of fresh fuel assemblies, number of reinsertion of used assemblies, selection of assemblies for discharge, and allocation of each fuel assembly in a two-dimensional core geometry. Division of the total problem into six phases permits usage of the most effective method in each phase. This study employed such techniques as linear programming for regionwise shuffling optimization, linear iterative search for the optimal EOC state, the minimum integrated k-deviation method for a guess allocation, and direct search for the optimal allocation of each fuel assembly, etc., all of which are interrelated. The applicability of this method to a commercial light-water reactor was demonstrated for a 1300-MW(th) boiling-water reactor by successfully generating a ten-cycle refueling schedule using a fixed enrichment of initial and reload fuel and allowing reinsertion of discharged fuel assemblies from the first to the third cycles. The results indicate a savings of as much as 14% of the fresh fuel consumption over a conventional mixed four- and five-batch scatter loading, with thermal characteristics well within design limits. (auth)

24603 SUMMARY OF OPERATING U. S. POWER REACTORS AS OF NOVEMBER 1, 1974. Nucl. Safety; 16: No. 1, 98-100(1975).

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 24586, 24593, 24597, 24600, 24601–24603, 24674, 24929, 24938, 24942, 24955, 24956, 24960, 24968, 24970, 25039, 25083, 25084, 25096, 25097, and 25106.

24604 (BAW-3647-32) PHYSICS VERIFICATION PROGRAM, PART III, TASK 11. Quarterly Technical Report, July–September 1974. Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va.

(USA). Research and Development Div.). Feb 1975. Contract AT(11-1)-3109. 15p. Dep. NTIS $4.00.

In experimental Task 11, the reactivity and power perturbation effects of poison pins in mockups of 17 by 17 fuel assemblies are being measured. The experimental facility—a water-moderated, slightly enriched UO_2 lattice—is arranged to mock up the fuel assemblies of a commercial pressurized water reactor. Each assembly contains 24 poison pin positions. (auth)

24605 (BAW-10001-A) IN-CORE INSTRUMENTATION TEST PROGRAM. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Dept.). Feb 1973. 42p.

In-core flux monitors are used in Babcock & Wilcox-designed central station power reactors to provide power distribution information to confirm physics calculations and to execute a fuel management program. To qualify the all-solid self-powered detector as an in-core monitoring device, B&W initiated several programs to qualify this device for the operating environment of a PWR. These programs included the following features: (1) Determination of the detector's basic physics characteristics. (2) Lifetime tests in a radiation environment. (3) Mechanical integrity tests of the detector and its assembly. Test results may be summarized as follows: (1) The electrical resistance of the detectors does not change as a result of prolonged exposure. (2) The rhodium neutron sensitivity decreases predictably as a function of neutron exposure, and the depletion of sensitive material can be accurately estimated without using external calibration devices. The detector is spectrum sensitive and can be computer compensated for variations in the flux spectrum. The background effects can be closely approximated for all axial positions by using a single background detector. (3) Reproducibility between detectors can be controlled by manufacturing quality control procedures. (4) The all-solid detector is highly reliable; there was no failure of any detector that met specifications upon installation. (5) The assembly developed for central station use permits manual insertion-withdrawal with only small forces, and without the use of lubricants. The assembly seal proved to be highly reliable and was quickly installed. (6) Both computers and conventional picoammeters provide accurate readings of the detector output. (7) There is no indication of lifetime limitation other than sensitivity loss resulting from neutron interaction. (auth)

24606 (BAW-10071-A) SPLIT: DIGITAL STEADY-STATE FLOW DISTRIBUTION CODE FOR VARIOUS PRIMARY SYSTEM PUMP COMBINATIONS. Galan, V. J.; Miller, C. K. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1974. 21p.

SPLIT is a digital computer code that resolves the steady-state flow distribution in the primary coolant system of a PWR plant with various pump combinations. The program includes the option to determine the flow split for two- and three-loop systems. SPLIT is characterized by low running times and compact printout. Multiple-use runs are an option. (auth)

24607 (BMFT-FB-K-74-03) INVESTIGATION OF THE BEHAVIOUR OF TUBE MATERIALS FOR STEAM GENERATORS OF PRESSURIZED WATER REACTORS. Wieling, N.; Stieding, L. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1974. 191p. (In German). INIS.

The corrosion behavior of tube materials used or proposed for steam generators of PWRs was investigated in various kinds of tests. Samples of the materials were put in the primary and secondary circuit of a KWO-steam generator and in pressure water autoclaves for long-time tests, as well as for short-time corrosion tests. Alloy 800 scored highest in corrosion resistance of all the materials tested. (auth)

24608 (WCAP-2397) REACTOR NOISE MEASUREMENTS ON THE SAXTON REACTOR. Rajagopal, V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA), Atomic Power Div.). Oct 1963. Contract AT(30-1)-3269. 39p. (CONF-332-15). Dep. NTIS $5.00.

From symposium on noise analysis in nuclear systems; Gainesville, Florida, USA (Nov 1963).

Experimental analysis of the inherent fluctuations (noise) in a nuclear power reactor has been conducted with a view to determine applications to the characterization of dynamics of power reactors, and to provide experience in applying such techniques. An analog spectrum analyzer was employed. Measurements of the power spectra and cross-power spectra of the fluctuations in nuclear power, coolant flow, temperature, and counting rate during shutdown have been performed at various reactor power levels. Applications and the usefulness of noise analysis in obtaining information on the dynamic behavior of a power reactor are discussed. (auth)

24609 (WCAP-8183(Rev.2)) OPERATIONAL EXPERIENCE WITH WESTINGHOUSE CORES (UP TO OCTOBER 1974). Plocido, V. J.; Schreiber, R. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1974. vp.

The cumulative operating experience of Westinghouse zircaloy-clad fuel rods and associated core components is evaluated. (JWR)

24610 STRUCTURAL ANALYSIS OF A THREE-DIMENSIONAL PERFORATED PLATE BY THE FINITE ELEMENT METHOD WITH TEST CORRELATION. Yoon, K. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.); Golembeski, T. S. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). Nucl. Eng. Des.; 29: No. 1, 33-38(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

An application of the finite element method to a three-dimensional perforated plate structure is presented using a nested modeling technique. Stresses calculated by a general three-dimensional finite element computer program were compared with those obtained from a model test. The structure considered in this analysis is a plenum cover of a pressurized water reactor internal which is a circular perforated plate stiffened with welded cross ribs. This type of structure is common in reactor internals. The nested model analyses consist of two finite element models; one is for the overall structure model and the other for an isolated portion of the structure with refined grid system for more accurate stress calculation. The first model was analyzed to obtain the nodal displacements under the applied loads. Then the second model was run using the displacement boundary conditions obtained from the first model analysis. A fully instrumented plexiglas model test was conducted to verify this method. Comparison between the test results and the calculated stresses from the second model analysis showed good agreement. (auth)

24611 CALCULATIONAL PROCEDURE FOR DETERMINING CREEP COLLAPSE OF LWR FUEL RODS. Merckx, K. R. (Exxon Nuclear Co., Richland, Wash. (USA)). Nucl. Eng. Des.; 31: No. 1, 95-101(Nov 1974).

Observed collapses in pressurized water reactor fuel rods have been attributed to the radiation enhanced creep of Zircaloy cladding into regions where separations in the fuel pellet stack have occurred. A computer code, COLAPX, has been written to determine the growth of ovality and the ultimate collapse of fuel rod cladding under reactor operating conditions. The theoretical bases of this code, the finite element formulation used, the constitutive relations between the displacement fields and the element forces, and the radiation, temperature and stress dependent material model for creep of Zircaloy tubing are presented. Comparisons of the creep rate predictions and of the ovality predictions with data from irradiated tubes and fuel cladding are presented. (auth)

24612 DYNAMIC ANALYSIS OF NONLINEAR PIPE WHIP RESTRAINTS. Palusamy, S.; Patrick, W. L.; Cloud, R. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Nucl. Eng. Des.; 31: No. 1, 106-116(Nov 1974).

A pipe whip restraint utilizing the dissipative capacity of a plastically deforming element has been developed. The transient dynamic behavior of the pipe and the restraint is studied using a discrete mathematical model consisting of non-linear spring, mass, and damper elements. The forcing function is a fluid dynamic transient resulting from a break in a main steam line which is part of a Westinghouse pressurized water reactor (PWR) nuclear plant. An extensive parametric study shows the relative influence of gap, restraint support rigidity, the elastic and plastic behavior of pipe, break opening time, and finally the change in restraint mass on the behavior of the pipe restraint system. (auth)

24613 TEMPERATURE MONITORING IN NUCLEAR POWER PLANTS (TIHANGE). Montmayeur, R. (Etablissements Merlin et Gerin, Grenoble, France). Ind. At. Spatiales; 18: No. 1, 13-19 (Jan 1974). (In French).

Analog data monitoring in a nuclear plant can be done by means of multidirectional graph recorders. However, due to the high range of magnitudes to monitor, this solution proved quite rapidly to be too costly and difficult to handle. At Tihange, three MGS 240 scanners can monitor 720 temperatures. As soon as one of them exceeds the threshold or lapses over the assigned range, the unit audibly warns the operator and identifies the faulty channel by means of an individual indicator light on a signaling board. The operator can then follow up on the abnormal temperature by using a jack to plug in this channel into one of the standard graph recorders provided for this purpose. (FR)

24614 USE OF THE PAS-1 FINITE ELEMENT COMPUTER SYSTEM FOR STATIC AND DYNAMIC ANALYSIS OF TWO- AND

THREE-DIMENSIONAL STRUCTURES. Brusa, L.; Ciacci, R.; Greco, A.; Ticozzi, C. (CISE-Segrate, Milan). Energ. Nucl. (Milan); 22: No. 1, 41-50(Jan 1975).

From international symposium on discrete methods in engineering; Milan, Italy (16 Sep 1974).

PAS-1 is a general computer system designed to perform static and dynamic analysis of linear structural systems using the finite element method. Static analysis can be, at present, performed for plane stress, plane strain, axisymmetric and solid three-dimensional structures with different types of elements and loading conditions. Dynamic analysis is carried out by means of the modal superposition method and, on option, seismic analysis can be performed using the response spectrum method. Plane stress, plane strain, three-dimensional beam and solid elements are currently available. A brief outline of the main features of the computer system is given together with some examples of various applications including the static analysis of the three-dimensional cylinder-cylinder intersection, the static and dynamic analysis of a double curvature arch dam, the vibration analysis of heat exchanger tubes, and the seismic analysis of a concrete gravity dam. (auth)

24615 SYSTEM FOR CONCENTRATING A MODERATING SOLUTION UTILIZED IN A PRESSURIZED WATER NUCLEAR POWER PLANT. Dunnavant, A. A.; Giardina, A. R.; Vargo, A. M.; Vota, J. L. (to Westinghouse Electric Corp.). US Patent 3,839,159. 1 Oct 1974. Filed date 30 Nov 1971. 10p.

A system for concentrating a solution of boric acid solution to a predetermined concentration and stripping the radioactive gases from the solution is described. The system is generally operable so that there is a continuous feed of weak boric acid solution and a continuous discharge of pure water from the system during the concentrating portion of the cycle and the system is operable so that when the boric acid solution reaches a predetermined concentration, the weak acid feed and pure water discharge are shut off, the pure water is recirculated through the system until the boric acid of predetermined concentration is removed to storage tanks. The system has sequentially operated controls which minimize the thermodynamic shock as the system is switched from the recycle portion of the cycle to the distillate discharge portion of the cycle. (Official Gazette)

24616 REACTOR CORE COMPONENT VIBRATION MONITOR. Carteus, M. F. M.; Gopal, R.; Rawle, D. T. (to Westinghouse Electric Corp.). US Patent 3,860,480. 14 Jan 1975. Filed Date 29 Jan 1973. 6p.

An on-line method and system is disclosed which employs the neutron signals emanating from the core of a nuclear reactor to monitor reactor core component vibration. At least two neutron detectors are disposed at diametrically opposed spaced points around the periphery of the core. The phase relationship of the spectral components of the respective signals generated by the detectors provides information as to both the magnitude and direction of the motion of the core. By subtracting the respective detector signals an out-of-phase signal is obtained, which is proportional to the amplitude of the core component lateral vibration along the line of the detectors. Similarly, by adding the respective detector signals an in-phase signal is obtained, which is proportional to the amplitude of the core component vertical vibration transverse to the line of the detectors. Additional means for normalizing the corresponding A. C. and D. C. components of the respective signals provides vibration measurements which are independent of reactor power level. The addition of a second pair of diametrically opposed neutron detectors around the periphery of the core in spaced relationship to the first pair of detectors provides information which completely defines the magnitude and direction of core vibration. (Official Gazette)

24617 NUCLEAR REACTOR ARRANGEMENT AND METHOD OF OPERATING SAFE EFFECTIVE TO INCREASE THE THERMAL MARGIN IN HIGH POWER DENSITY REGIONS. Zmola, P. C.; Rickert, R. J. (to Combustion Engineering, Inc.). US Patent 3,861,999. 21 Jan 1975. Filed Date 13 Nov 1968. 12p.

A description is given of a nuclear reactor cooled by a moderating fluid and a method of operating such a reactor wherein a portion of the coolant directed through the reactor and over the fuel elements is conveyed in bypass relation with the first portion of the reactor core such that it maintains generally its initial or entering temperature. This bypassed portion is then introduced at spaced intervals into regions of high power density so as to decrease the enthalpy of the coolant at these regions and thereby improve the margin to burnout and, accordingly, improve the power generation capability of the reactor. Flow management is obtained in an open core by regulating the bypassed portion of the coolant in a manner such that hotter core regions receive a greater proportion of the total flow than colder core regions thereby further improving the thermal margin and accordingly the power generating capability of the reactor. (Official Gazette)

24618 FUEL ASSEMBLY FOR A NUCLEAR REACTOR. Jabsen, F. S. (to Babcock and Wilcox Co.). US Patent 3,862,884. 28 Jan 1975. Filed Date 21 Nov 1972. 4p.

A description is given of a nuclear reactor fuel assembly containing a plurality of parallel and adjacent fuel rods and guide tubes. The upper grid of the assembly has parallel rows of T-shaped slots with the upper end of each fuel rod having a T-shaped key for supporting engagement within the T-shaped slots. (Official Gazette)

24619 COOLANT MIXING VANES. Pugh, R. A.; Sofer, G. A.; Leach, C. E. (to Exxon Nuclear Co., Inc.). US Patent 3,862,000. 21 Jan 1975. Filed Date 31 Aug 1972. 6p.

Mixing vanes are so arranged on certain sections of nuclear reactor spacer grid to provide a vortex flow of coolant about each intersection of the fuel assemblies in the reactor. This flow produces a mass transfer of coolant between adjacent assemblies and between regions within each assembly. (Official Gazette)

24620 DRUCKWASSERREAKTOREN FUER KERNKRAFTWERKE. (Pressurized Water Reactors for Power Plants). Oldekop, W. (ed.); Aleite, W.; Bartholome, G.; Boehm, W.; Debray, W.; Frei, G.; Holzer, R.; Kausz, I. A.; Martin, A.; Putschoegl, G. Thiemig-Taschenbuecher. Muenchen, F. R. Germany; Thiemig (1974). 350p.

The pressurized water reactor (PWR), moderated and cooled with light water, form today together with the boiling water reactor (BWR) the basis for using nuclear energy. As all PWR designs are much the same, the present book has been divided into special fields were the Biblis nuclear power plant is often taken as an example. These fields comprise among others the reactor physical design, the circuits, nuclear technical equipment, instrumentation, control, safety problems, operating experience, and development tendencies. Each special field is presented by an expert himself working on the development. The book presents the technology of a reactor type which will certainly be an essential part of the contribution to solving the energy crisis in the next decade and will occupy a new, prospering branch of industry. (auth)

24621 EXPERIENCE WITH THE NUCLEAR INSTRUMENTATION OF THE NUCLEAR POWER PLANT STADE. P. 2. Klar, E.; Schaffer, S.; Spillekothen, H. G. Atomwirt., Atomtech.; 19: No. 11, 542-546(Nov 1974). (In German).

The nuclear instrumentation of the nuclear power plant Stade is a prototype valid for all KWU-pressure vessel reactors. While the core instrumentation in the predecessor of Stade, the nuclear power plant Obrigheim, consisted of the pebble measuring system and temperature measurement inside the core, the instrumentation in the nuclear power plant Stade was enlarged by a system of fixed core detectors. The operational application of fixed incore detectors under power reactor conditions is described. For the first time experience with the behaviour of miniature fission chambers and of neutron-beta-detectors is presented on a large scale. The results have been obtained during the period of start-up to the first refuelling operations. Also, the difficulties occurring in connection with the prototype instrumentation are described in detail. (auth)

24622 THE NUCLEAR POWER PLANT UNTERWESER AT THE MIDDLE OF 1974. Emonts, H. Energiewirt. Tagesfragen; 24: No. 10, 488-489(Oct 1974). (In German).

About half of the construction time scheduled for the building of the 1,300 MW nuclear power plant Unterweser is over. The development of the licensing procedure, the state of the building progress, the procedure of the supply of components and the planned further continuation are discussed. (GE)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 24603, 24932–24936, 24970, and 25079.

24623 (GA-A-13097) GAS TURBINE HTGR TRADE-OFF STUDIES: TURBOMACHINERY ORIENTATION AND RATING. (General Atomic Co., San Diego, Calif. (USA)). 1 Aug 1974. Contract AT(04-3)-167. 140p. Dep. NTIS $10.00.

The results of engineering studies that have been conducted of the Gas Turbine HTGR Power Plant to determine the preferred turbomachinery orientation and the loop size for an 1100-MW(e)/3000-MW(t) plant rating are summarized. The studies have included preparation of design layouts of several alternative plant configurations and evaluation of these configurations from the standpoint of feasibility, development, licensing, cost, maintenance, operation, utility acceptance, and growth potential. Based on the

results of these evaluations, the Gas Turbine HTGR Project has adopted a configuration that incorporates three 370-MW(e) loops with the turbomachinery mounted in horizontal cavities in the PCRV bottom head. (auth)

24624 (GA-A-13209) FORT ST. VRAIN SURVEILLANCE AND TESTING PROGRAM. Quarterly Progress Report for the Period July 1, 1974–September 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 30 Oct 1974. Contract AT(04-3)-167. 5p. Dep. NTIS $4.00.

The current status of the surveillance and testing program is briefly summarized. (JWR)

24625 (NDS-5(Vol. 1)) VOLUME I. System Analysis. Steam Generator Plenum Service System. Phase 1. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 273p. Dep. NTIS $16.75.

An analysis is presented on the primary functions to be performed by a system for the inspection and maintenance of structures and equipment in the HTGR steam generator plenum. (JWR)

24626 (NDS-5(Vol. 2)(Ph. 1)) VOLUME II. Equipment Design Criteria and Descriptions. Steam Generator Plenum Service System. Phase 1. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 280p. Dep. NTIS $17.00.

Design standards are presented for equipment used in the HTGR steam generator plenum service system. (JWR)

24627 (NDS-5(Vol. 3)(Phase 1)) VOLUME III. Equipment Preliminary Design Drawings. Steam Generator Plenum Service System. Phase 1. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 158p. Dep. NTIS $11.00.

Design drawings are presented for the remote handling equipment to be used in removing and replacing a steam generator module from the HTGR PCRV plenum area. (DCC)

24628 (NDS-5(Vol.4)(Phase 1)) VOLUME IV. EQUIPMENT PRELIMINARY DESIGN CALCULATIONS. Steam Generator Plenum Service System. Phase 1. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 183p. Dep. NTIS $12.25.

24629 (NDS-5(Vol. 5)(Phase 1)) VOLUME V. Equipment Operation and Engineering Analysis. Steam Generator Plenum Service System. Phase 1. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 54p. Dep. NTIS $5.75.

The following equipment installation/removal sequence describes, in chronological order, the steps required to remove and replace a steam generator module from the PCRV plenum area. It is written primarily for the remote removal and replacement of the plenum area components but it is also applicable to the manned condition with slight modifications. The sequence was established after studying all detailed operations necessary to perform the various functions and includes steps to maintain the helium environment within the plenum area, remove components, perform inspection, transfer radioactive components, and install new components. It also includes the installation of a fixture for proof-loading the steam generator handling rails to 200% of actual load prior to use. The service system equipment is identified throughout the sequence where it is being utilized. (auth)

24630 (NDS-5(Vol. 6)) VOLUME VI. Program Planning, Phases II Through V. Steam Generator Plenum Service System. Phase I. Preliminary Design. Final Summary Report to Gulf General Atomic, Inc. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. Dep. NTIS $8.75.

Program plans are presented for mockup demonstration, detail design, manufacturing and procurement, acceptance test and demonstration, and quality control for the HTGR steam generator plenum service system. (JWR)

24631 (TID/SNA-174) PROPOSAL NO. 681023 TO GULF GENERAL ATOMIC INC. FOR STEAM GENERATOR PLENUM VIEWING SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 96p. Dep. NTIS $8.00.

This proposal covers the design, fabrication, assembly, testing and delivery of a steam generator plenum viewing system for the Fort St. Vrain Nuclear Generating Station. (TFD)

24632 (TID/SNA-177) STEAM-GENERATOR INSTALLATION EQUIPMENT. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1968. 15p. Dep. NTIS $4.00.

For Gulf General Atomic, Inc.

A program for the fabrication, assembly, inspection, and acceptance testing of HTGR steam-generator installation equipment is presented. (JWR)

24633 DEVELOPMENT PROGRAM FOR THE FORT ST. VRAIN THERMAL BARRIER. Jones, G.; Brislin, R. T. SAMPE Quart.; 6: No. 2, 29-34(Jan 1975).

The development program undertaken by General Atomic Company in order to design, fabricate, and install a thermal barrier on the inner surface of the prestressed concrete reactor vessel (PCRV) of the Fort St. Vrain High-Temperature Gas-Cooled Reactor (HTGR) is described. This thermal barrier is required to function in a helium environment at pressures of 5.0 MPa and temperatures up to 1090°C. A summary of the requirements to be met in insulating the internal surfaces of PCRVs for HTGR applications and the many differences between these applications and more conventional uses of fibrous insulating materials are given. 3 references. (auth)

24634 UNDERSTANDING AGR CORE PHYSICS. Young, J. D. (Central Electricity Generating Board, Berkeley, Eng.). CEGB Research; No. 1, 4-11(Dec 1974).

The Berkeley Nuclear Laboratory reactor physics program was initiated to bridge the gap between the early Atomic Energy Authority work on prototype reactor cores and the somewhat modified designs to be used in CEGB power reactors. More sophisticated calculation methods, developed by the UKAEA and coupled with better-quality basic data, have been tested in the context of the advanced gas-cooled reactors. They have allowed significant reductions in the initial fuel enrichment to be specified and have also shown the core power distribution to be unexpectedly sensitive to small perturbations. This has led to an extension of reactor-commissioning programs and has emphasized the importance of in-core instrumentation. An outline is given of the nature of the problems facing the reactor physicist. Their importance in practical terms, and some idea of the extent to which their solution is now understood are also illustrated. (UK)

24635 FULL-SCALE MODEL TEST OF HOT SPOTS IN THE PRESTRESSED CONCRETE PRESSURE VESSELS OF OLDBURY NUCLEAR POWER STATION. Irving, J. (Central Electricity Generating Board, London); Carmichael, G. D. T.; Hornby, I. W. Proc. Inst. Civil Eng. (London); 57: 331-351(Jun 1974).

A small number of local shortcomings in the performance of the as-installed thermal insulation of the concrete pressure vessels at Oldbury nuclear power station resulted in hot spots occurring in the liner and surrounding concrete. An experimental investigation was conducted to ascertain the seriousness of damage, if any, to the liner and concrete which would result from the hot spots. The investigation consisted of testing a full-scale model of the region of the vessel local to the upper boiler instrument penetration where the highest liner temperatures had been recorded during commissioning trials. In the test a thermal profile with a hot spot was established, representing conditions in the vessel. This profile was maintained for three months. Instruments were included so that measurements could be made of the strains, temperature, vapor pressure at the liner/concrete interface, the moisture content, and the formation of cracks in the concrete. After the test the model was examined for signs of damage by cutting out sample cores and by ultrasonic probing. The experimental and theoretical results are described, and their significance with respect to full-scale concrete pressure vessel behavior is discussed. (auth)

24636 GETTING THE MOST FROM MAGNOX FUEL. Harris, J. E. (Central Electricity Generating Board, Berkeley, Eng.). CEGB Research; No. 1, 29-35(Dec 1974).

More than half a million nuclear fuel elements are being irradiated in CEGB Magnox power reactors. A fuel element consists of a uranium rod encased in a finned can of ductile magnesium-aluminium alloy (Magnox) which protects the rod and transfers heat to the surrounding coolant gas stream. The combination of heat, irradiation, and accumulation of fission products leads to physical deterioration of the fuel, so that elements have to be discharged some time before their potential nuclear reactivity has been exhausted. Over a ten-year period, the CEGB has maintained a fuel-monitoring program of a kind unprecedented for an electrical utility. In collaboration with the UK Atomic Energy Authority and British Nuclear Fuels Limited, about 1,100 fuel elements are examined each year. The identification of the causes of deterioration and occasional failure has allowed fuel-irradiation times before discharge to be progressively extended. Power from the most efficient of the Magnox stations is already cheaper than that from the best of the fossil-fuel-fired stations in Britain. This margin is expected to widen in the future. (auth)

24637 METHOD OF MANUFACTURE OF NUCLEAR REACTOR FUEL ELEMENTS. Devillard, J. (to Commissariat a l'Energie Atomique). French Patent 2,181,468/A/. 25 Apr 1972. 5p. (In French).

The method comprises manufacturing an envelope, or sheath, by dry-moulding a mixture of graphite and powdered resin without exerting any pressure, submitting said envelope to a coking treatment, subsequently filling said envelope with a mixture of fissile material and graphite particles, closing the thus filled envelope and treating same with a gaseous hydrocarbon. This method can be applied to high temperature reactors. (FR)

24638 NUCLEAR REACTOR. Tilliette, Z. (to Commissariat a l'Energie Atomique). French Patent 2,182,648/A/. 2 May 1972. 19p. (In French).

A description is given of a nuclear reactor, in particular a high temperature reactor, comprising, in a vessel, a main cavity containing the core and a plurality of vertical cylindrical sockets, or cells, distributed about said main cavity, each of said sockets communicating with said cavity via two collecting ducts for the primary fluid downwardly crossing the reactor core. This reactor is characterized in that each of said sockets contains two superimposed steam generating groups, said groups being substantially symmetrically mounted on either side of the hot primary fluid collecting duct which drives said hot fluid from the reactor main cavity into the socket, the blowers of said two groups being mounted at the sockets lower and upper ends, respectively. (FR)

24639 EXPERIMENTAL OPERATION OF CONDENSATE TREATMENT UNITS AT THE SAINT-LAURENT-DES-EAUX POWER STATION. Hospitel, J. (Societe de Recuperation Thermique et d'Epuration, Paris); Notot, A. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 106, 19-30(Mar 1974). (In French).

The purpose of the process is simultaneously to stop impurities in suspension and fix the traces of dissolved salts entering the water circuit. The process includes an initial single filtration stage on a 150 μ sieve followed by a second high speed filtration stage on ion exchange resins. The installation and ancillary equipment are described, and the results of the analyses made in the three following operational cases are given: rinsing of the circuits after their assembly in 1970, normal working operation, and the entry of untreated water into the condenser. The difficulties encountered during use (regeneration of resins in particular) are given. (FR)

24640 FULL-SCALE MODEL TEST OF HOT SPOTS IN THE PRESTRESSED CONCRETE PRESSURE VESSELS OF OLDBURY NUCLEAR POWER STATION. Discussion. Irving, J. (Central Electricity Generating Board, London); Carmichael, G. D. T.; Hornby, I. W. Proc. Inst. Civil Eng. (London); 57: 795-798(Dec 1974).

Questions concerning full-scale tests of hot spots in the Oldbury pressure vessel are discussed, and a challenge is made to the conclusion that, despite high thermal stresses induced in the concrete and the possibility of cracking in the vicinity of the liner, there would not be cause for concern about the safety margin against failure. (UK)

24641 INTEGRATING HIGH TEMPERATURE REACTORS IN A CHEMICAL WORKS. Beatson, C. Engineer; 239: No. 6196, 36-37(12 Dec 1974).

Highlights from some of the papers given at the BNES Conference in London on process applications of the HTR are discussed. If useful heat can be provided by the HTR at about 900°C, many potential applications exist for industrial processes including conversion of fossil fuels and refining of metal ores. The details of such processes are not clear. To link the HTR with remote energy consuming plants will require a transportable and preferably a storable form of energy. Two applications which are discussed include the gasification of coal and the integration of an HTR with an ammonia/methane/hydrogen chemical works. Lines of approach are also suggested for design studies planned for the VHTR. Reference is made to research in Germany and Japan. (UK)

24642 KERNEL MIGRATION IN COATED CARBIDE FUEL PARTICLES. Stansfield, O. M.; Scott, C. B.; Chin, J. (General Atomic Co., San Diego, CA). Contract AT(04-3)-167. Nucl. Technol.; 25: No. 3, 517-530(Mar 1975).

Pyrocarbon-coated microspheres of UC_2, ThC_2, and (Th, U)C_2 utilized in fuel for high-temperature gas-cooled reactors will migrate up an imposed thermal gradient during service life. The degree of kernal migration is limited by appropriate core design to retain coating integrity. The kernel migration (amoeba effect) results from carbon transport in the fuel phase and is characterized by a rejected graphite layer on the cool side of the kernel. The thermal gradient provides the dominant driving force for the rate-controlling process, which is the self-diffusion of carbon in the fuel phase. All di-carbide kernel materials show similar kernel migration behavior; however, ThC_2 has the most rapid migration rate. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstract 24969.

24643 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 7. Technical-Scientific Session. Toronto; Canadian Nuclear Association (9 Jun 1974). vp. (CONF-740681-P7; 74-CNA-700).

Separate abstracts are included for 2 of the 3 papers presented concerning fuel management for power reactors and heavy water management. One paper has previously been abstracted and can be found in the NSA Report Number Index under CONF-740681-P7 and 74-CNA-700. (DCC)

For abstracts of individual papers see: 24644 and 24645.

24644 ON-POWER FUELLING SYSTEM DEVELOPMENTS. Zimmermann, K. G. (Atomic Energy of Canada Ltd., Peterborough, Ont.). pp Paper TS-2, 21p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 7. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

The "dedicated" on-power fuel-handling system in operation at Pickering A Nuclear Power Station is compared with the "shared" system at Bruce A (where one pair of fueling machines will serve all four reactors). The design for Gentilly-2 emphasizes access to the machines from behind screening. The trend toward standardization of CANDU reactors will not impede the evolution of fueling machines. The present emphasis is on efficiency and reliability of the total system, rather than on making components work. For Pickering Units 1 and 2 in 1973, incapacities of the fueling machines only very slightly exceeded expectations. (CA)

24645 FUEL SCHEDULING. Brown, R. A. (Ontario Hydro, Toronto). pp Paper TS-3, 13p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 7. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

Fuel scheduling experience at Ontario Hydro is described. Fuel scheduling means the process of defining the pattern of fuel replacement in a reactor. Both Douglas Point Generating Station and Pickering GS are discussed—the former's reactor uses differential fueling and boosters for flux flattening and poison override respectively, while the latter uses cobalt filled rods called adjuster rods for both functions. The fuel for both reactors is in the shape of a bundle containing cylindrical elements filled with natural UO_2—19 such elements for Douglas Point and 28 for Pickering. (auth)

24646 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 2. CANDU Program and Research Installations. Toronto; Canadian Nuclear Association (1974). vp. (CONF-740681-P2; 74-CNA-200).

Separate abstracts are included for 2 of the 5 papers presented concerning CANDU power reactor operations and nuclear research facilities in Canada. Three of the papers have previously been abstracted and included in NSA and can be found in the NSA Report Number Index under CONF-740681-P2 and 74-CNA-200. (DCC)

For abstracts of individual papers see: 24647 and 24716.

24647 EXPERIENCE WITH CANDU REACTORS OUTSIDE OF CANADA: KANUPP, KARACHI, PAKISTAN; RAPP, RAJASTHAN, INDIA. Graham, R. J. (Canadian General Electric Co. Ltd., Toronto); Stevens, J. E. S. pp Paper 203, 39p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 2. Toronto; Canadian Nuclear Association (1974).

Separate sections are presented on the 137 MW(e) KANUPP nuclear power station in Pakistan, and the 2 × 220 MW(e) RAPP station in Rajasthan, India (of which the second unit is still under

construction). KANUPP was a turn-key project supplied by Canadian General Electric. Atomic Energy of Canada Limited was responsible for the nuclear side of RAPP, but many components were manufactured in India. India plans to build two CANDU-type units at Narara (near Delhi), and two south of Madras. Pakistan also plans more nuclear power. Details of operating experience are given. Particular problems encountered include climatic conditions (leading to corrosion), flooding, supply and transport difficulties, heavy-water shortage, fluctuations in electricity consumption, and war. The necessity for load-following at KANUPP, and discrepancies between bundle powers predicted by the code STOKE and actual values may have contributed to some fuel defects. Generally, however, on-power fueling has been successful at both KANUPP and RAPP. Power output from RAPP I has been less than the designed rating, because of a decision to use only fresh natural uranium fuel in the initial loading, but during a drought RAPP produced most of the electricity in Rajasthan. (CA)

24648 TUBE TROUBLES ON CANDU. Nucl. Eng. Int.; 19: No. 223, 1024-1026(Dec 1974).

An account is given of a detailed investigation which is still proceeding into leakages detected in some Zr–Nb pressure tubes in Pickering-3 reactor. The problem is thought to be associated with high residual stresses left in a localized area near the rolled joints between the pressure tube and the end fittings. Crack propagation in these areas could have been accelerated by cold pressurization of the reactor. (UK)

Power Reactors, Breeding

Refer also to abstracts 22384, 22538, 24698, 24924, 24925, 24927, 24931, 24934, 24937, 24945, 24946, 24949, 24967, and 25106.

24649 (ANL-CT-75-24) DNB INDUCED THERMAL STRESS AND FATIGUE IN LMFBR EVAPORATOR TUBES WITH OXIDE SCALE. Chiang, T.; France, D. M.; Bump, T. R. (Argonne National Lab., Ill. (USA)). Dec 1974. 79p. AT.

Transient temperature distributions and thermal stresses were calculated for a sodium heated steam generator evaporator tube and water side oxide layer in the region of departure from nucleate boiling (DNB). The pertinent parameter ranges and geometry were adopted from the Atomics International reference design for the steam generators of the Clinch River Breeder Reactor Plant. The tube wall and the oxide scale layer on the water side of the tube (treated as either a powdery substance or a dense protective film) were subjected to periodic water heat transfer coefficient fluctuations simulating the effect of DNB in that area of the tube. The stresses obtained were employed in estimating (where possible) the life expectancy of the steam generator tube based on fatigue of the tube wall and repeated exfoliation of the oxide layers. (auth)

24650 (ANL-Trans-963) PROBLEMS RAISED BY EXPULSION OF THE SODIUM BOND IN A CARBIDE FUEL ELEMENT FOR FAST NEUTRON REACTORS. Truffert, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). Dec 1974. Translation of Problems Poses par la Chasse du Joint Sodium Dans un Element Combustible Carbure Pour la Filiere a Neutrons Rapides. 11p. Dep. NTIS $4.00.

The accidental expulsion of the sodium bond from a carbide fuel pin constitutes the basis for safety studies of this type of fast-reactor fuel element. The result of a theoretical study of the resulting cladding temperature elevation is given. An experimental device in CABRI and the characteristics which should permit a first verification of the calculations are described. (auth)

24651 (BNWL-B-365) FLOW-INDUCED VIBRATION ANALYSIS AND TEST PLAN FOR GENERAL ATOMIC GAS-COOLED FAST REACTOR CORE ELEMENTS. Loscutoff, W. V.; Anderson, W. E.; Henager, C. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-1830. 24p. Dep. NTIS $4.00.

An experimental program to study and correlate flow-induced vibrations of the GCFR core elements over the anticipated range of operating conditions is described. This information will provide the required information on vibrational behavior of the core elements for design and licensing. The overall objective of this program is to provide analytic and experimental evidence to assure the absence of potentially damaging flow-induced vibrations in the GCFR fuel, blanket, and control elements. (auth)

24652 (BNWL-B-390-1) SUBCHANNEL CODE DEVELOPMENT AND DATA ANALYSIS. Progress Report, July 1–December 31, 1974. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-1830. 24p. Dep. NTIS $4.00.

Progress is described with special emphasis on LMFBR activities in the continued development of the COBRA code as a general computer method for subchannel and reactor core analysis. Included is a presentation and discussion of two basically different numerical techniques which are under evaluation in COBRA to allow calculation of flow reversals in the presence of pressure boundary conditions. These techniques are referred to as the pressure-velocity and vorticity-velocity methods. A discussion of several major changes to the code which allow analysis of large bundles (217 pins) is given. Methods are also presented which reduce computer storage requirements and running time. LMFBR data analysis, calibration, and verification of COBRA for LMFBR bundle analyses under steady state conditions are discussed. An evaluation of the applicability of COBRA to compute flow and enthalpy distributions in LMFBR bundles under boiling conditions is presented. An experimental program to study buoyancy-dominated flows through a heated rod bundle is described. This study will be used to verify and implement the COBRA code in the buoyancy dominated flow region with application directed toward analysis of LMFBR blanket assemblies. (auth)

24653 (BNWL-tr-137) IRRADIATION OF DFR-409. Anselin, F. Translation of Bull. Inform. Sci. Tech. (Paris); 27-40(Oct 1974). 30p. Dep. NTIS $4.50.

Several stainless-steel-cladded mixed oxide fuel pins have been irradiated in the DFR reactor up to 13.7 at.% burnup and 1.05×10^{23} n/cm^2 (TREFOIL DFR 409). The dimensional changes of the pin (axial elongation, two peak diametral strain profile, anisotropy of distension: axial versus diametral) in relation with the two different steel swelling mechanisms by void formation and the two different irradiation creep mechanisms of the clad (one athermal, the other thermally activated) were determined. The fuel column/pin axial elongation mechanisms and the corresponding evolution of the fuel microstructure were also determined. Several types of damages observed on the inner face of the clad, either at the fuel column level of the UO_2 insulator pellets which act as a sink for some specific fission products (iodine and cesium), are described. The end of life pin failure which occurred at one junction fuel column-insulator pellet in one pin and the consequences of the sodium penetration at very high burnup were observed. This irradiation was for the verification of the behavior of a fuel element in one of the reference designs selected for the Phenix reactor. (auth)

24654 (CEA-CONF-2678) FAST NEUTRON REACTORS IN FRANCE: THE RESEARCH AND DEVELOPMENT PROGRAMME AND ITS MAIN PHASES. Vendryes, G. (CEA, 75–Paris (France)). May 1974. 12p. (In French). (CONF-740577-1). Dep. NTIS (US Sales Only) $4.00.

From French industrial and scientific exposition; Pekin, France (16 May 1974).

The role of LMFBR type reactors in the French long range plans for electric power generation is described. Progress in fast reactor technology achieved through the Rapsodie and Phenix programs is discussed together with current activities involving the Super Phenix. (DG)

24655 (CONF-740709-3) NUCLEAR STEAM SUPPLY SYSTEM FOR THE CLINCH RIVER BREEDER REACTOR PLANT. Kenney, J. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). [nd]. 24p. Dep. NTIS $4.00.

From Power Engineering Society summer meeting and energy resources conference; Anaheim, California, USA (14 Jul 1974).

The Reference Design of the Clinch River Breeder Reactor Plant has been defined. Conceptual and preliminary designs have proceeded to the point where long lead material for the reactor vessel and intermediate heat exchangers has been placed on order, the reactor vessel and the containment vessel are in the bidding cycle and a number of equipment specifications are in the approval process prior to issue for bid. Baseline schedules have been developed which establish a plan for project completion which results in initial criticality by mid 1982. (auth)

24656 (CONF-740964-1) SODIUM VALVE MANUFACTURING DEVELOPMENT. Zemanick, P. P. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 23 Sep 1974. Contract AT(45-1)-2171. 16p. Dep. NTIS $4.00.

From specialists meeting on operating experience and design criteria of sodium valves; Richland, Washington, USA (23 Sep 1974).

Some items of special interest from recent USA experience with the manufacture of sodium valves are reviewed. The items discussed are: (1) valve forging fabrication, (2) welding processes, (3) hardfacing processes, (4) multi-dimensional machining, and (5) bellows fabrication. (auth)

24657 (COO-3049-5, pp 32-66) HIGH TEMPERATURE AEROSOL FILTRATION BY DIFFUSION. Kornberg, J. P.; First, M. W. Dec 1974.

In semiannual progress report, March 1, 1974–August 31, 1974.

Recent technological developments, such as the use of liquid metals to cool the forthcoming generation of breeder reactors, have created a need to examine whether diffusional filter theory adequately describes collection at high temperatures (500-1000°K) where both gas viscosity and the efficiency of deposition by diffusion increases. Three filters, each composed of monodisperse fibers with diameters of 4 μm, 8 μm, and 12 μm were tested with spherical NaCl particles ranging in size from 0.022 μm to 0.178 μm at filter face velocities of 6.0, 11.6, and 20 cm/sec and at filter temperatures of 357°K, 561°K, and 711°K. The pressure drop characteristics of the test filters were measured. A computer aided, multiple regression analysis, examining the dependence of single fiber efficiency upon temperature, fiber diameter, particle diameter and filter inlet velocity, identified fiber diameter as a variable responsible for part of the differences observed between theory and experiment. The conclusion was reached, therefore, that discrepancies between theory and experiment were caused, at least in part, by particle counting errors and difficulties encountered with the 12 μm filter experiments. The observation that the experimental regression exponent of temperature is not in disagreement with that predicted by theory supports the conclusion that current diffusional filtration theory can be used to predict filter efficiencies at high temperatures. (38 references) (auth)

24658 (ERDA-1) REPORT OF THE LIQUID METAL FAST BREEDER REACTOR PROGRAM REVIEW GROUP. (USERDA, Washington, D. C.). Jan 1975. 124p. TIC Free.

A special staff study was made of the LMFBR Program with particular reference to the Clinch River Breeder Reactor (CRBR) Project. The purpose of the review was to reassess the need for and timing of the LMFBR in light of the latest information available and to determine if the purpose and schedule of the CRBR are compatible with that need and the state of LMFBR technology. The review was a prudent reexamination to determine whether new factors, e.g., the CRBR cost estimate and recent reductions in energy demand growth, affect the need for or pace of the LMFBR program and the Clinch River Project. Emphasis was placed on the examination of the uranium supply and demand question, and the possible impact of the licensing process on the CRBR schedule. The review confirms the need to proceed expeditiously with the LMFBR program. (auth)

24659 (ERDA-tr-3) STEAM GENERATORS DEVELOPED IN FRANCE FOR THE SUPER PHENIX. Robin, M. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). [nd]. Translation of Generateurs de vapeur developpes en France pour SUPER PHENIX. (CONF-741085-4). 21p. Dep. NTIS $4.25.

From symposium on steam generators for liquid metal fast breeder reactors; Bensberg, F.R. Germany (14 Oct 1974).

The development program of steam generators studied by Fives-Cail Babcock and Stein Industrie Companies, jointly with CEA and EDF, for the SUPER PHENIX 1200 MW(e) Fast Breeder Power Plant, is presented. The main characteristics of both sodium heated steam generators are emphasized and experimental studies related to their key features are reported. New helical tube and straight tube steam generators developed in France for SUPER PHENIX are described and their characteristics are compared with those of equipment now operating on PHENIX. (auth)

24660 (ERDA-tr-4) STEAM GENERATOR PERFORMANCES OF PHENIX IN STEADY STATE: COMPARISON WITH FORECASTS. Robin, M. G.; Duchatelle, L.; DeNucheze, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). [nd]. Translation of Performances des Generateurs de Vapeur de PHENIX en Regime Permanent: Comparaison Avec les Previsions. (CONF-741085-5). 24p. Dep. NTIS $4.25.

From symposium on steam generators for liquid metal fast breeder reactors; Bensberg, F.R. Germany (14 Oct 1974).

Theoretical and experimental performances and temperature development were calculated and measured on a comparative basis in steady state using prototypes and steam generators of the PHENIX fast breeder demonstration power station. The experimental results were produced on a module at the Thermal Test Center of the CEA (Commissariat à l'Energie Atomique, Atomic Energy Commission) at Grand Quevilly in 1968-1969, then on three prototype modules operating in parallel on the test circuit of sodium-heated steam generators (CSSG) of Electricité de France (EDF) at Renardières in 1972, and finally with 12 modules by generator on the PHENIX Power Station at the beginning of 1974. It is shown that, as early as 1969, it was possible to make a fair prediction of full load performance of the steam generator selected for PHENIX. (auth)

24661 (ERDA-tr-5) EFFECT OF SMALL WATER LEAKAGE INTO SODIUM IN TUBES OF THE PHENIX STEAM GENERATOR GROUP. Biscarel, J.; LaFon, A.; Lions, N. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Div. d'Etudes et de Developpement des Reacteurs). [nd]. Translation of Effet de Petites Fuites d'eau dans le Sodium sur les Tubes du Faisceau des Generateurs de Vapeur de PHENIX. (CONF-741085-2). 18p. Dep. NTIS $4.00.

From symposium on steam generators for liquid metal fast breeder reactors; Bensberg, F. R. Germany (14 Oct 1974).

The effects of wastage caused by small water or steam leakage into the sodium were studied in the PHENIX steam generator geometry. The rate of loss of thickness of materials is studied as a function of various characteristic parameters. The metallurgical analysis of the craters only showed a slight surface modification of the structure in the case of two unstabilized ferritic steels and an austenitic steel. The comparison between the ferritic and austenitic steels pointed up the fact that, in their rated operating conditions, these materials have essentially the same behavior with respect to the wastage phenomenon. (auth)

24662 (ERDA-tr-6) PHENIX STEAM GENERATORS: MEASURING HYDROGEN CONCENTRATION OF SODIUM FOR TIGHTNESS INSPECTION OF WATER–STEAM TUBES. Cambillard, E.; LaCroix, A.; Langlois, G.; Viala, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). [nd]. Translation of Generateurs de Vapeur de PHENIX: Mesure de la Concentration d'hydrogene du Sodium Pour la Surveillance de l'Etancheite des Tubes d'eau-Vapeur. (CONF-741085-3). 21p. Dep. NTIS $4.25.

From symposium on steam generators for liquid metal fast breeder reactors; Bensberg, F. R. Germany (14 Oct 1974).

The PHENIX secondary circuits are provided with measurement systems of hydrogen concentration in sodium that allow for the detection of possible water leaks in steam generators and the location of a faulty module. A measurement device consists of: a detector with nickel membranes of 0.3 mm wall thickness, an ion pump with a 200 l/s flow rate, a quadripole mass spectrometer and a calibrated hydrogen leak. The temperature correction is made automatically. The tests mainly concerned, in addition to conventional testing: degassing of vacuum circuits, monitoring of mass spectrometers by means of calibrated leaks, control of flow rates of sodium sampled, confirmation of operation of sodium selectors, injections of hydrogen for calibration of measuring chains and the determination of response time of the sodium, in particular at low temperatures. Since the installations became operational (24 October 1973), the measurements performed have allowed determination of hydrogen diffusion rates through the steam generator exchange tube walls. (auth)

24663 (EURFNR-1178) HEXAGONAL NETWORKS AND TRUSSES. Computer-Based Automation of Network Formation and Redundancy Analysis. Zehlein, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1974. Translation of KFK-1947. 18p. Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Topological aspects of hexagonal networks representing equivalent trusses for the simulation of rod bundle deformation under transverse loading are examined. Certain types of accidents within a Fast Breeder Reactor may lead to permanent deformations of the fuel rods, to reactivity changes, and to danger for the safety system. Therefore the simulation of the deformation of rod bundles under transverse transient loading is an important part of the dynamic structural analysis for a FBR-Core. It is proposed to use the idea of a tension-free ersatz-truss to model the force diffusion and distribution within the bundle section. It is shown how some typical characteristics of hexagonal nets may be utilized for setting-up the model automatically. In particular an automatic mesh generator is described. It not only calculates the nodal coordinates but also determines simultaneously and recursively for a chosen number of rows within the net the incidence matrix required for book-keeping purposes. Even the selection of the redundant forces (so-called "structural cutting") may be delegated to the computer for automatic execution. The appertaining procedure is derived from a theorem concerning the redundancy of the equivalent hexagonal network. The proof of this theorem is given. (auth)

24664 (KFK-2077) CONTROL ROD WORTH AND POWER DISTRIBUTION MEASUREMENTS IN THE SNR MOCK UP SNEAK ASSEMBLY 9A. Pinter, M.; Boehme, R.; Durance, G.; Fehsenfeld, P.; Giese, H.; Pilate, S.; Wehmann, U. (Kernforschungs-

zentrum Karlsruhe (F. R. Germany)). Nov 1974. 92p. Dep. NTIS (U. S. Sales Only) $7.75.

The series of assemblies which were built for investigations with regard to the SNR was continued with the Assembly SNEAK-9A. This assembly was a mock up of the SNR with two core zones in the radial direction. The fuel material was enriched uranium. The main objectives were control rod worths and power distribution measurements. Most of the calculations were performed with the group diffusion method using 4 energy groups. The most important result is a general underestimate of the control rod worths. The power distribution shows in general an overestimate in the upper, and an underestimate in the lower core half. This effect may also be related to the underestimate of the control rod worths. (auth)

24665 (ORNL-TM-4794) FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT FOR APRIL AND MAY 1974. 189a No. 10028, Activity No. HN 04 01 01 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 121p. AT.

Experimental results obtained for a simulated lower axial shield, designed and fabricated by Atomics International as a part of the LMFBR Demonstration Plant development program are described. The objective of the experiment was to provide results which could be used to evaluate the adequacy of calculational techniques for predicting neutron streaming through control rod penetrations in the lower axial shield and also for predicting neutron transport in the unperturbed lower axial shield. The neutron fluence and spectra emerging from five different shield configurations were measured. Also measured were the neutron fluence and spectra within special penetrations reaching to the center line of the configuration at a number of locations in a mock-up of the complete lower axial shield and grid plates. The complete set of experimental results for the shield configurations provided by Atomics International are presented. (auth)

24666 (RCN-219) FAST REACTOR PROGRAMME, COMBINED SECOND AND THIRD QUARTERS 1974 PROGRESS REPORT. Hoekstra, E. K. (comp.). (Stichting Reactor Centrum Nederland, The Hague). Nov 1974. 86p. Dep. NTIS (US Sales Only) $7.50.

Final evaluation of the central neutron spectra of five STEK cores, determination of the reactivity worths of isotopic samples, and development of codes for cross section evaluation are discussed. Results of out-of-pile burst tests on tubes of fuel cladding material exposed to hot sodium are compared with those on tubes of this material in the as-received condition, and fuel pin post-irradiation examination results are given. Attempts to prepare UC powders of low oxygen content and with a large surface area are reported. Fatigue crack growth rates in DIN 1.4948 stainless steel measured at room temperature and at 550°C are given. A mathematical model of the quantitative decay of an aerosol in an enclosed condensing atmosphere is described. Thermal noise analysis and single and two-phase sodium heat transfer experiments in a 12-rod bundle are described; the fission and Nusselt multipliers and thermal performance for constant pumping power, calculated from the measured heat transfer data of three artificially roughened rods in flowing air are given. (auth)

24667 (WAPD-TM-1013) CRITICAL HEAT FLUX AND PRESSURE DROP TESTS WITH PARALLEL UPFLOW OF HIGH PRESSURE WATER IN BUNDLES OF TWENTY 0.25- AND 0.28-INCH DIAMETER RODS (LWBR DEVELOPMENT PROGRAM). LeTourneau, B. W.; Peterson, A. C.; Coeling, K. J.; Gavin, M. E.; Green, S. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jan 1975. Contract AT(36-1)-GEN-14. 137p. Dep. NTIS $10.00.

Critical heat flux and pressure drop tests were run with vertical upflow of water parallel to 20-rod bundles at 400 to 2000 psia and mass velocities from 0.05×10^6 to 4.0×10^6 lb/hr-ft^2. The heated rods were 0.25 or 0.28 in. O.D. × 54 in. heated length, arranged in a 5 × 4 array on a 0.340 inch equilateral triangle pitch in a rhombic shroud channel. The effects of rod pitch/diameter ratio and rod-to-rod/rod-to-shroud dimension ratio were investigated. Five different rod support system designs were tested as well as various axial arrangements of rod support locations. Tests were run with uniform heat flux, linearly nonuniform transverse heat flux, and nonuniform axial heat flux distributions. (auth)

24668 (WAPD-TM-1170) CRITICAL HEAT FLUX AND PRESSURE DROP TESTS WITH PARALLEL UPFLOW OF HIGH PRESSURE WATER IN BUNDLES OF TWENTY-NINE 0.301 INCH DIAMETER RODS WITH A NONUNIFORM RADIAL AND AXIAL HEAT FLUX DISTRIBUTION (LWBR DEVELOPMENT PROGRAM). Peterson, A. C.; Green, S. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jan 1975. Contract AT(36-1)-GEN-14. 48p. Dep. NTIS $5.50.

Critical heat flux and pressure drop data were obtained for vertical upflow of water in a 29-rod bundle. The rods were 0.301 inches in diameter arranged on a 0.368 inch triangular pitch in a hexagonally shaped shroud. Half-hex grids were used to support the rod bundle at nine axial locations. The heated length of the rods varied across the bundle from 28 inches to 84 inches. The heat flux varied both axially and transversely across the bundle. Data were taken at 520°F inlet temperature, 2000 psia system pressure, and mass velocities from 1.0×10^6 lb/hr-ft^2 to 3.0×10^6 lb/hr-ft^2. The 29 rods were not all heated for every run due to rod failures. Thus, data were obtained with 29, 28 and 26 heated rods. (auth)

24669 AN EVALUATION OF PIN-TO-PIN FAILURE PROPAGATION DUE TO FISSION GAS RELEASE IN FUEL SUBASSEMBLIES OF LIQUID-METAL-COOLED FAST BREEDER REACTORS. van Erp, J. B.; Chawla, T. C.; Fauske, H. K. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 128-150(Nov 1974).

A survey is given of work performed to evaluate the potential for pin-to-pin failure propagation due to fission gas release in fuel subassemblies of LMFBRs. Reference is made to publications available in the open literature; recent experiments and analyses are dealt with in more detail. Two distinct failure propagation mechanisms are identified, namely: (1) thermal transients, and (2) mechanical loads. It is concluded that rapid and extensive pin-to-pin failure propagation due to fission gas release is not possible, even for the very high gas release rates considered. (auth)

24670 FLUID-SOLID INTERACTION OF REACTOR CORE COMPONENTS, A PRELIMINARY ANALYSIS. Krajcinovic, D. (Illinois Univ., Chicago (USA)); Carey, J. J. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 87-94(Nov 1974).

A simple analytical model is used to examine the mechanical interaction of LMFBR core components with the surrounding coolant. Approximating a subassembly duct by a single degree of freedom oscillator and the coolant by a thin layer of viscous fluid, the problem was reduced to a nonlinear differential equation governing the motion of the oscillator. Approximate analytical and numerical solutions are presented which enable parametric studies useful in LMFBR core design. (auth)

24671 A DESIGN GUIDE FOR CALCULATING LIQUID-METAL TURBULENT FORCED CONVECTION HEAT TRANSFER WITH NON-UNIFORM HEAT FLUXES AND TRANSIENTS. Minkowycz, W. J.; Stein, R. P. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 21-30(Nov 1974).

Calculation of turbulent forced convection heat transfer in ducts during non-uniform wall heat fluxes and transients is of interest to the national liquid-metal fast breeder nuclear reactor program. An improved method whereby such heat transfer can be determined during analysis and design is presented. Since the method involves the use of fully developed, steady-state heat transfer coefficients, several dimensionless coefficients and selected physical properties, tables, graphs, or equations are included for the convenience of the designer. Application of the improved method is specialized to four geometries of interest: circular tube, parallel-plate channel, annular space, and approximation of pin or rod bundle. (auth)

24672 ELECTROMAGNETIC PUMPS AND FLOWMETERS FOR FAST-REACTOR DEVELOPMENT. Childs, B. M. (General Electric Co. Reactor Equipment Ltd., Whetstone, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 6, 357-364(Jun 1974).

In addition to their use in fast reactors, electromagnetic methods are being applied in chemical engineering and the bulk handling of liquid metals. The principles of the electromagnetic pumps and transverse-field flowmeters in common use are explained. These include dc conduction pumps, ac conduction pumps, linear induction pumps, transverse-field electromagnetic flowmeters and transverse-field permanent-magnet flowmeters. An illustration is given of the use of dc conduction pumps in fuel cladding failure-detection equipment in the PFR. The relative merits of the different systems are summarized. (UK)

24673 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Wolff, P. H. W. (to British Nuclear Design and Construction Ltd.). British Patent 1,367,451/B/. 18 Sep 1974. Filed date 29 Jul 1970. 9p.

A prestressed concrete pressure vessel reactor is described in which the core is asymmetrically disposed within the pressure vessel and supported from below on a base structure that restrains its movement relative to the pressure vessel due to asymmetrical thermally generated forces arising from the asymmetry of the component layout. The pressure vessel contains a pool of cold liquid coolant in which the core, heat exchangers, and coolant circulators are immersed, the coolant circulators being arranged to draw coolant from the cold pool, and the primary sides of the

heat exchangers being arranged to discharge cooled coolant into the cold pool. The primary side of each heat exchanger may be arranged to discharge cooled coolant into a mixing zone, into which is also discharged cooled coolant from the primary side of at least one other heat exchanger, the mixing zone being arranged to discharge into the cold pool. The top of the reactor core is surrounded by a dam within which hot coolant discharged from the reactor core is retained to form a hot pool, separated from the cold pool, the heat exchangers being connected so that their primary sides are supplied with hot coolant from the hot pool. Pump means are provided for establishing a gas pressure excess within the dam and above the hot pool, thereby depressing the level of the hot pool. Sensing means control the pump. An improved pressure vessel construction is also described. (UK)

24674 INSTALLATIONS FOR STORING OR HANDLING ENVIRONMENT POLLUTING FLUIDS. (to Societe Babcock-Atlantique). French Patent 2,178,291/D/. 27 Mar 1972. 11p. (In French).

A vessel containing a noxious fluid is mounted in a tank acting in the manner of a secondary barrier (or shield) should said vessel happen to rupture. With a view to preventing the fluid level in the vessel from undesirably dropping, the space between said vessel and the tank is furnished with blocks adapted to roll on a circular track. An opening for a radial track is provided in the tank for admitting an inspection or repair truck into said space and bringing said truck to the desired location. (FR)

24675 FAST BREEDER REACTORS. Carle, R. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Fr. Energ.; 25: No. 265, 187-195(Aug 1974). (In French and English).

The status of the French fast breeder program through Phenix realization stages is described. The planned Super Phenix 1200 MW(e) plant is intended to be the first commercial reactor of this type. The essential performance characteristics of this type of reactor are reviewed. The Phenix 450, a 1050 MW(t) power station which can either supply 450 MW(e) or produce both electrical power and steam, is considered. (FR)

24676 MOLTEN SALT REACTORS. Grenon, M. Rev. Fr. Energ.; 25: No. 263, 477-487(May 1974). (In French).

All current projects are based on the use of a single fertile-fuel salt and two neutron zones obtained by varying the properties of the moderator (highly moderated core, slightly moderated envelope). The carrier salts must be able to dissolve large quantities of U or Th and those selected are fluorides (thermal neutrons) and chlorides (fast neutrons). The primary circuit must be made of a material resistant to molten fluoride attack and to the effects of neutron bombardment, such as Hastelloy-N. Certain components of the salt, lithium 7, beryllium, and even fluorine slow down neutrons, but thermalization is completed by a block of graphite impervious to the salt and to gases. To obtain high breeding rates it will be necessary to extract fission products and protactinium as quickly as possible after their formation. The main advantages of these reactors are reviewed: thermal neutron breeding with the ^{233}U-Th cycle, small overall investment, high load factors corresponding to continuous operation, and safety. (FR)

24677 FLIGHT OF THE PHENIX. Kenward, M. New Sci.; 64: No. 922, 425-426(7 Nov 1974).

The 250 MW(e) Phenix reactor, France's prototype breeder reactor, went critical in August 1973 and reached its design output in March 1974. It is thought that the cost is within 10% of the budgeted cost and completion was on time. The reactor has proved easy to run according to those whose job it has been to keep the system operating into the grid for the last six months. When the target of a billion kWh of electricity generation is passed, France will make a decision on the next stage of its fast reactor program, a 1200 MW(e) Super Phenix. The site has been selected, and Italy and West Germany have joined the project. If construction starts in 1975 it could be completed in 1980-1981. (UK)

24678 BIRTH OF THE BIG BREEDERS. Valery, N. New Sci.; 64: No. 922, 423-424(7 Nov 1974).

Britain's £45 million Prototype Fast Reactor (PFR) will soon be generating power, and the reactor, which first went critical in March 1974, will then be worked up to its designed thermal output of 600 MW to deliver a net 250 MW(e) to the grid. Present urgency in commissioning large-scale breeders is due to the fact that uranium utilization goes up from about 1% with thermal reactors to around 50% using breeders, and a breeder program is therefore a method of insuring against price inflation in the uranium market. Troubles which have been encountered to date by the PFR have mostly been concerned with the constructional engineering and steam plant and not on the nuclear reactor itself. The design for the first commercial fast reactor (CFR-1) is described and compared with the present PFR. Although the PFR has shown a 15% cost overrun, it is claimed to have cost £20 million less than the French Phenix but has taken considerably longer to build. (UK)

24679 DEVICE FOR HANDLING FUEL-ASSEMBLIES IN THE CORE OF A NUCLEAR REACTOR. Dupuy, G. (to Commissariat a l'Energie Atomique). French Patent 2,184,488/A/. 18 May 1972. 14p. (In French).

The device is characterized in that it comprises two synchronously controlled arms, the tubular portions of which are connected by means of a member in which both can slide, said tubular portions being in addition, adapted through a differential control system, to be imparted motions corresponding to the same stress but in opposed directions so that the lateral reaction exerted by the first arm gripper on a fuel-assembly is equal, but oppositely directed, to the lateral reaction of the cylindrical member of the second arm on the same fuel-assembly. (FR)

24680 HEAT-EXCHANGER MODULUS. Pouderoux, P.; Salon, G.; Andro, J. (to Societe Stein Industrie). French Patent 2,171,869/E/. 11 Feb 1972. 9p. (In French).

The heat-exchanging unit according to the invention comprises two interlocked networks of tubes in which flow two different fluids. In the vicinity of at least one of the ends of each bundle of tubes, the tubes are in the shape of expansion twists (or torsades) forming one or several symmetrical networks and adapted to constitute equilateral or square meshes and to minimize the transverse stresses exerted on the supports and the torques at places where the tubes are embedded in their holding plates. (FR)

24681 SYSTEM OF GAS COOLED FAST BREEDER REACTORS: COMPETITIVE ENERGY WITH BREEDING. Ind. At. Spatiales; 18: No. 3, 33-43(May 1974). (In French).

The reactor GBR-4 is described. This reactor is used as reference for economic, safety, research and development studies on fast gas-cooled reactors and as guide for the definition of the demonstration reactor. It uses pin type fuel and is helium-cooled. The main specifications are given for two short-term versions of a 1200 MW(e) station of this kind. The economic aspects and development possibilities of such reactors are discussed. (FR)

24682 PARAMETRIC STUDY OF THE POWER CONVERSION SYSTEM REPRESENTED BY A FIELD CYCLE COUPLED TO AN ADVANCED STEAM-COOLED CONVERTOR REACTOR. Osterle, J. F.; Impink, A. J. Jr.; Lipner, M. H. (Carnegie-Mellon Univ., Pittsburgh). pp 221-226 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The Field cycle is a variation on the regenerative Brayton cycle made possible by the use of a condensible vapor as the working fluid. With water as the working fluid, a coupling of the Field cycle to a steam cooled convertor reactor becomes a possible power conversion system. The feasibility of this system both from the standpoint of reactor characteristics and conversion efficiency is analyzed. The Field cycle operating parameters include the pressure and temperature of the steam entering the first stage turbine, the turbine efficiency, the turbine outlet/regenerator inlet pressure, the regenerator effectiveness, the efficiency and moisture limits of the second stage turbine, the condenser pressure, and the compressor efficiency. Reasonable values or ranges for these parameters are established, and the effect of their variation on the thermal efficiency determined. Thermal efficiencies on the order of 40% seem to be attainable over a rather wide range of steam pressures in the reactor core. (7 references) (auth)

24683 GIBR-4: CONCEPT OF A 1,200 MWe GAS BREEDER NUCLEAR POWER STATION. A Study on Security and Economy of a GBR. Chermanne, J. (European Association for Gas-Cooled Breeder Reactor (GBR), Brussels (Belgium)). Atomwirt., Atomtech.; 19: No. 10, 484-487(Oct 1974). (In German).

3 figs.; 2 tabs.

The GBR association, in the framework of its design, safety and profitableness investigations in the field of gas-cooled fast breeder reactors, has given an experts' opinion on the concept of a 1,200 MW(e)-GBR (GBR-4) with rod-shaped fuel. The study lead to conclusions which call for an intensification of the gas breeder development for reasons of securing the long-term energy supply, operational and safety technical advantages, economical advantages and lower development costs. The GBR association propose the building of a 600 MW(e)-GBR demonstration plant within the framework of European cooperation. (GE)

24684 RESTRAINTS AND ANCHORS FOR BREEDER REACTOR SODIUM COOLANT PIPING. Reis, E. (Atomics International, Canoga Park, CA); Van Meter, W. Heat., Piping Air Cond.; 46: No. 11, 53-61(Oct 1974).

Sodium-water reaction pressures and temperatures following steam generator tube rupture in a fast breeder reactor would impose tremendous loading on coolant and relief piping systems. The challenging design of pipe restraints and anchors in a facility for testing effects of such reactions is described. (auth)

24685 HANDLING SYSTEM FOR A NUCLEAR REACTOR. Marmonier, P.; Sauvage, M. (to Commissariat a l'Energie Atomique). US Patent 3,862,001. 21 Jan 1975. Priority Date 14 Aug 1970, France. 4p.

A description is given of a fuel element handling system for a nuclear reactor which comprises two rotary plugs which close the reactor vessel. The smaller rotary plug is mounted eccentrically within the larger plug which rotates relatively to the reactor wall. The smaller plug is rotatable relatively to the larger plug and supports at least one fuel element handling channel. Control rod passage mechanisms are distributed in the larger plug and in the smaller plug and a reactor core cover portion is rigidly connected to each of the plugs. The arrangement enables the dimensions of the vessel containing the core to be restricted to a diameter substantially the same as that of the core. (Official Gazette)

24686 METHOD OF OPERATING A NEUTRONIC REACTOR. Okrent, E. H.; Tarmy, B. L. (to Exxon Research and Engineering Co.). US Patent 3,861,998. 21 Jan 1975. Filed Date 23 May 1973. 6p.

A novel system and method of operating a fluid-fueled nuclear reactor is provided in which heat for power generation is transferred directly from the fluid fuel to a purge material while the purge material simultaneously sweeps neutron-absorbing fission products from the fluid fuel. (Official Gazette)

24687 METHODS OF AND APPARATUS FOR DETECTING A FAILED FUEL ASSEMBLY. Tomabechi, K. (to Doryokuro Kakunenryo Kaikatsu Jigyodan). US Patent 3,856,620. 24 Dec 1974. Priority Date 20 May 1971, Japan. 6p.

A method of detecting a failed fuel assembly in a nuclear reactor is disclosed which comprises separately sampling the coolant flowing out of a plurality of fuel assemblies; blowing a carrier gas into each of said coolant samples; collecting all of said carrier gas after separating the gas from said coolant; detecting radioactivity of said collected gas; and then separately detecting radioactivity of each of said carrier gas samples by blowing a carrier gas into each of said coolant samples seriatim in the event the collected gas is found to be radioactive. Also, an apparatus for detecting a failed fuel assembly in a nuclear reactor is provided which comprises a plurality of tubes to separately sample the coolant which is flowing out of a plurality of fuel assemblies and to extract the fission products by means of a carrier gas from said coolant samples; a plurality of gas blowing means each having a valve means through which said carrier gas can be blown into said sampled coolant seriatim; a gas collecting chamber associating with said tubes to collect gas blown into said coolant samples; and means for detecting radioactivity of said collected gas. (Official Gazette)

24688 FUEL PIN SECURING APPARATUS. Kinzer, J. E.; Fallandy, M. A. (to Rockwell International Corp.). US Patent 3,857,755. 31 Dec 1974. Filed Date 11 Mar 1971. 4p.

A fuel pin hold-down and spacing apparatus for use in nuclear reactors is disclosed. Fuel pins forming a hexagonal array are spaced apart from each other and held down at their lower end, securely attached at two places along their length to one of a plurality of vertically disposed parallel plates arranged in horizontally spaced rows. These plates are in turn spaced apart from each other and held together by a combination of spacing and fastening means. The arrangement of this invention provides a strong vibration free hold-down mechanism while avoiding a large pressure drop to the flow of coolant fluid. This apparatus is particularly useful in connection with liquid cooled reactors such as liquid metal cooled fast breeder reactors. (Official Gazette)

24689 STUDIES ON THE PHYSICAL CHARACTERISTICS OF THE BN-350 REACTOR. Orlov, V. V.; Pomerantsev, G. B.; Yurchenko, D. S. (State Committee for the Utilization of Atomic Energy, Moscow). Kernenergie; 17: No. 11, 345-350(Nov 1974). (In German).

The results of measurements of the static characteristic of the fast power reactor BN-350 are presented. The reactor became critical on November 29, 1972. The obtained values are compared with predetermined ones. 12 references. (auth)

24690 EPITHERMAL TO INTERMEDIATE SPECTRUM PRESSURIZED HEAVY WATER BREEDER REACTOR. Radkowsky, A.; Conley, G. H.; Ryals, H. W.; Hanson, J. N.; Cohen, J. D.; Weinreich, W. A. III. (to Energy Research and Development Administration). US Patent 3,859,165. 7 Jan 1975. Filed date 13 Oct 1972. 14p.

A pressurized heavy water moderated nuclear reactor having an epithermal to intermediate neutron spectrum is provided which is characterized by an improved breeding ratio in comparison with previously existing pressurized heavy water moderated reactors. The neutron spectrum having an energy distribution between those of fast and thermal reactors results from the restriction of the moderator-to-fuel atom ratio to range from 0.35 to 4.0. Three pressurized heavy water reactor designs using the inventive moderator-to-fuel atom ratio range are described: two with a uniform lattice configuration and one with a seed-blanket arrangement. (Official Gazette)

24691 RADIONUCLIDE BEHAVIOR DURING NORMAL OPERATION OF LIQUID-METAL-COOLED FAST BREEDER REACTORS. I. Production. Erdman, C. A.; Reynolds, A. B. Nucl. Safety; 16: No. 1, 43-59(1975).

The behavior of radionuclides produced during the normal operation of a liquid-metal-cooled fast breeder reactor (LMFBR) is discussed. The results given are primarily from the literature, but several independent calculations are included. Numerical results are normalized to a 1000-MW(e) LMFBR and are compared with a similar size light-water reactor. Sources of radioactivity studied include plutonium and other transuranic elements, fission products, tritium, corrosion products, activation products, and tramp fuel. The review also includes data on radioactivity taken from the operating experiences of LMFBRs. Data are included for the fast reactors EBR-II, Fermi, SEFOR, Dounreay, Rapsodie, and BR-5, with limited data for the thermal reactors SRE, S8ER, and Hallam. 59 references. (auth)

24692 RADIATION CONDITIONS DURING SERVICING OF FAST POWER REACTOR FACILITY BOR-60. Kizin, V. D.; Polyakov, V. I.; Chechelkin, Yu. V.; Kevrolev, V. P.; Levin, L. M.; Rybakov, V. N. At. Energ. (USSR); 37: No. 6, 471-474(Dec 1974). (In Russian).

Radiation conditions in the servicing rooms of power reactor facility BOR-60 when operating with a contaminated coolant have been determined. It has been shown that during normal reactor operation there are neither radiation fields nor contamination of surfaces and air in personnel rooms. It is noted that no heavy biological shielding is necessary on the gas lines of the plant. The draining of primary loop sodium results in an insignificant reduction of the exposure dose rate (on the average, by a factor of 1.5 per box). Removable large-sized equipment components may be replaced using light confining hoods without biological shielding. (auth)

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Refer also to abstracts 24205, 24257, 24646, 24656, 24664, 24666, 24945, 24954, 24967, 25022, and 25120.

24693 (ANCR-1178) ANALYSES OF FAILURES WHICH OCCURRED DURING HEAT TREATMENTS OF THE INCONEL 718 PBF ACOUSTIC FILTERS. Smolik, G. R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Oct 1974. Contract AT(10-1)-1375. 68p. Dep. NTIS $5.45.

Problems experienced during the fabrication of the Inconel 718 Power Burst Facility (PBF) acoustic filters are discussed. Defects existed in the plate material which caused cracks to develop during a stress relief. In addition, cracks developed in the welded components during three subsequent heat treatments. Various studies were made to determine the cause of failures which occurred upon heat treating the Inconel 718 PBF acoustic filters. It has been established that Inconel 718 shows a time-dependent stress rupture-type failure associated with a minimum in ductility between 1300 and 1550°F. Stress rupture tests showed that stresses of 70 to 80 ksi would cause the acoustic filter material to fail in less than five hours. Stresses greater than 85 ksi were quenched into one filter when the unit was rapidly cooled from the solution anneal. These quenched-in thermal stresses caused this filter to fail during its aging cycle. Two other failures were caused by welding stresses as the units were heated through the susceptible temperature range (1300 to 1550°F). Slag inclusions rolled into the plates caused surface cracks during initial forming and stress relieving operations. It is concluded that higher welding stresses develop at fillet welds than at butt welded joints. The notch-shaped fillet welds also act as stress raisers increasing the possibility of failure. (auth)

24694 (ANL-8154) ANALYSIS OF HEXCAN DEFORMATIONS AND SOME COMPARISONS WITH OUT-OF-PILE EBR-II

SUBASSEMBLY DUCT EXPERIMENTS. Ash, J. E. (Argonne National Lab., Ill. (USA)). Dec 1974. Contract W-31-109-eng-38. 45p. Dep. NTIS $4.00.

Computer codes have been developed at Argonne National Laboratory to predict the response of reactor subassembly hexcans to pressure loads. Dynamic response computations for uniform pressurization of hexcans have been performed with the two-dimensional STRAW code, and correlations were made with out-of-pile hydrostatic experimental data for two EBR-II test can specimens. In addition to the two-dimensional analysis, three-dimensional effects were also treated. For a centrally located pressure-pulse source, the pressure load will attenuate along the hexcan axis. Computations of the dynamic response were made with the three-dimensional, finite-element structural code SADCAT. The pressure loading was computed with the implicit hydrodynamic ICECO code. The computed results are compared with the experimental deflection profile for a single EBR-II test can. From the comparisons, guidance for the planning and design of future experiments has been gained. Further experimental data are needed to extend the code verification. The high sensitivity shown in the computations of the hexcan response to the ductility of the stainless steel demonstrates that particular effort should be directed to the study of material-property effects. (auth)

24695 (ANSC-SSR06-A782) SCOPING STUDY REPORT, FFTF Interim Examination/Maintenance Cell. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 210p. Dep. NTIS $13.50.

A remotely operated facility known as the Interim Examination/Maintenance Cell (IEM) to be located below the main operating deck within the reactor containment vessel of the Fast Flux Test Facility (FFTF) is described. The facility is planned to provide capabilities for driver fuel disassembly, open and closed loop test train disassembly and reassembly, limited nondestructive examination of fueled reactor core components and limited maintenance of sodium contaminated radioactive plant equipment. Recommended IEM cell overall dimensions are presented. Required cell equipment, its function, overall size, operating space, budgetary planning fabrication cost, and interfaces between the cell equipment, other plant equipment, and the facility are identified. (auth)

24696 (CEA-CONF-2750) COLD AND ULTRA COLD NEUTRONS. A Test Facility for Cryogenic Engineering. Ageron, P.; Astruc, J. M.; Lacaze, A.; Verdier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1974. 7p. (CONF-740509-10). Dep. NTIS (U. S. Sales Only) $4.00.

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The design and operation of the cold neutron source and associated cryogenic equipment at the Grenoble HFR are described. (JWR)

24697 (GSF-P-54) FIELDS OF THERMAL AND FAST NEUTRONS IN THE CORE OF THE FRN DURING CONTINUOUS AND PULSED OPERATION. Egger, H.; Grundler, W.; Lock, O.; Stark, W.; Rau, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Apr 1974. 17p. (In German). INIS.

A description is given of the neutron field measurements carried out for the first time after the critical experiment at the research reactor Neuherberg FRN (type TRIGA–Mark III). The middle of the fuel pit (pos. II) is chosen as reference position of the core in order to guarantee a field pattern with relatively no interference from the surroundings of the core. The spatial arrangement of the flux density measuring probes and the dividing of the core volume into "measuring cells" due to this are dealt with in particular, and the profile bands of the thermal and fast neutron flux density measured with this geometry are also shown. (GE)

24698 (HEDL-TME-72-82(Rev.1)) STATUS REPORT ON FRICTION, WEAR, AND SELF-WELDING PROGRAM IN SUPPORT OF FFTF COMPONENTS, RM-23. Johnson, R. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1972. Contract AT(45-1)-2170. 52p. AT.

FFTF bearing material data needs are reviewed, information gained to date is summarized, and programs and facilities required to provide the remaining information are identified. (DG)

24699 (INIS-mf-1383, pp 104-108) STUDY ON NEUTRON SPECTRA ON FAST CRITICAL ASSEMBLIES. Kazanskii, Yu. A. 1973. (In Russian).

The methods used in the measurement of the neutron spectra in fast critical assemblies and their accuracy and principal differences are examined. The following methods are examined: time-of-flight methods, method using proportional counters, transmission method, and measurement by means of a ^{6}Li semiconductor spectrometer. The studies made showed that the neutron spectra can be measured in an energy range from ~100 eV up 10 MeV by the time-of-flight method, from 10 keV to 1 MeV by means of a hydrogen proportional counter, and above 100 keV by the ^{6}Li semiconductor spectrometer (or scintillation spectrometer at energies above 500 keV). In the energy region above 1 keV the neutron spectra can be obtained with an error no greater than 8% which is sufficient for the analysis of measured and calculated resonance integrals. (tr-INIS)

24700 (KFK-1956) OPERATION OF THE FR2 RESEARCH REACTOR IN 1972. Moeller, I.; Steiger, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Reaktorbetrieb und Technik). Oct 1974. 215p. (In German). Dep. NTIS (U. S. Sales Only) $13.75.

In 1972 the FR2 heavy water moderated research and materials testing reactor attained ten years of full load operation. For the first time, the cycle of operation was extended to a maximum of seven weeks. Six operating cycles of seven weeks duration each and two of six weeks duration each were run. Each cycle included a shutdown phase of roughly ten days in which fuel element shuffling, withdrawal and installation of experiments as well as maintenance, repair and inspection work took place. This new "operational mode" proved to be very successful, since it allows more continuous repair time and reactor startup on working days. The energy generated by FR2 in 1972 amounted to 12,222 MWd and reached about 87,728 MWd in total since the date of commissioning. Accordingly, the operating phases lasted 39 and — in the reduced cycles — 32 days, respectively, with the reactor largely working at 44 MW nominal power. The average burnup of all BE 8 type fuel elements withdrawn according to schedule and having an initial enrichment of 2% reached almost 15,000 MWd per ton of uranium. Adaptation of the shim/safety rods to new absorbers had been nearly completed by the end of the year. The number of reactor shutdowns due to failures occurring within the normal time of operation was 30 and consequently 10% lower than in the preceding year. (auth)

24701 (NDS-11) COMPUTER SOFTWARE DESIGN CONCEPTS CONTROL AND DATA-HANDLING SYSTEM FOR THE FAST-FLUX TEST FACILITY. Boerlin, H. E.; Porter, L. K. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Mar 1969. 23p. Dep. NTIS $4.25.

System operational areas requiring software were first identified and then examined for the best approach to provide a functional software solution. The software for each operational area is described in functional terms rather than as specific computer programs required. An estimate of manpower required and a schedule to provide the software described are included. (auth)

24702 (NPS-681105) STRESS WAVE ANALYSIS TECHNIQUE DEMONSTRATION PROGRAM FOR THE FAST FLUX TEST FACILITY (PHASE I). (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1968. 101p. Dep. NTIS $8.25.

A program for structural-failure warning, nondestructive testing, leak and boiling detection, and component malfunction-signature analysis at the Fast Flux Test Facility is described. (JWR)

24703 (ORNL-TM-4725) ANALYSIS OF DOSIMETRY DATA FROM THE ALUMINUM AND BERYLLIUM IRRADIATION EXPERIMENT IN THE RB-7 FACILITY OF HFIR. Kerr, H. T.; Allen, E. J.; Swanks, J. H. (Oak Ridge National Lab., Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

Flux monitors were recovered from the aluminum and beryllium irradiation experiment in the RB-7 facility of HFIR. The monitor activities are reported, and fluxes derived from the data are presented. The experimentally derived fluxes are in good agreement with fluxes calculated in a CITATION computational model of HFIR. A summary of definitions is given for various fluxes and cross sections. (auth)

24704 (RN-DR-0142) FAST-FLUX TEST FACILITY FUEL-HANDLING SYSTEM CONCEPTUAL DESIGN STUDY FINAL REPORT TO PACIFIC NORTHWEST LABS., A DIVISION OF BATTELLE MEMORIAL INSTITUTE. Supplemental Contract No. 1, Consultant Agreement BCA-367. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1968. 172p. Dep. NTIS $11.75.

During this program, four concepts were investigated: a wet, turret-type system, a dry system, a combination wet/dry turret-type system, and a wet, single-tube system. Feasible conceptual designs were developed for all except the totally dry approach. Each concept makes use of a single positioning and alignment system and has the capability of using interchangeable casks for handling the various routinely removable FFTF core components and experiments under a controlled environment, enabling maximum acquisition and preservation of data. Remote control with maximum visual monitoring of operations is utilized in each approach. The overall system requirements and assumptions,

definitions of nomenclature, technical approach, auxiliary equipment requirements, an evaluation of the totally dry approach, and descriptions of the developed concepts are presented. The descriptions are supported by design data, drawings, basic operational sequences, refueling time cycle estimates, development and risk areas, and a brief summary of inherent reliability, maintainability, and safety considerations. (auth)

24705 (RN-TM-0395) PRELIMINARY SHIELDING ANALYSIS FOR THE FAST FLUX TEST FACILITY. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Oct 1966. 40p. Dep. NTIS $5.00.

A preliminary analysis of the FFTF shielding problems has been completed. Both full power and shutdown conditions were considered to identify the shielding requirements imposed by specified access criteria. The case of a single "stuck-fuel element" is the controlling criterion for the top rotating shield. The required thickness was found to be 12-inches of steel followed by a portable 4-inch thick lead shield. Neutron leakage is the dominant contributor to the dose rate above the top rotating shield during full power operation. The required attenuation can be achieved by a number of alternative shield configurations. Some preliminary configurations include: (1) 30-inches of borated graphite with polyethylene plugs placed either in the reactor top shield or in the process shield in any desired combination, (2) 35-inches of borated graphite with borated graphite plugs placed as described above, and (3) 39-inches of borated graphite with sodium plugs placed as described above. The amount of lead shielding required around the fuel handling machine was found to be 10.6 inches. (auth)

24706 (TID/SNA-81) PRELIMINARY DRAFT: SEGMENTED MAINTENANCE CASK, MAINTENANCE FLOOR VALVE, AND ASSOCIATED HANDLING EQUIPMENT; FFTF PLANT. Ordering Data. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 60p. Dep. NTIS $6.00.

Ordering data to be used for the procurement of equipment necessary for maintenance of the FFTF are presented. (JWR)

24707 (TID/SNA-158) UNSOLICITED PROPOSAL FOR STUDY OF AN ALTERNATIVE CONFIGURATION SPLIT CONICAL CORE, FAST FLUX TEST REACTOR (FFTR). (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Nov 1967. 39p. Dep. NTIS $5.00.

For Battelle Pacific Northwest Labs., Richland, WA.

A study is presented on the effects of certain geometry changes on the performance, efficiency, and flexibility of the Fast Test Reactor. (JWR)

24708 (TID/SNA-159) STUDY OF ALTERNATE SPLIT CONICAL CORE FAST TEST REACTOR. Interim Presentation. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 7 May 1968. 24p. Dep. NTIS $4.25.

Preliminary engineering information on the trisected conical core concept for the Fast Test Reactor is presented. (JWR)

24709 (TID/SNA-175) INTEGRATION STUDY OF FUEL HANDLING AND RADIOACTIVE MAINTENANCE SYSTEMS, FAST FLUX TEST FACILITY. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1968. 125p. Dep. NTIS $9.25.

The scope of the work was to develop and identify alternate equipment and system arrangement concepts and operational flow patterns that best fulfill the functions and requirements of the Fast Flux Test Facility fuel handling and remote maintenance systems as defined by PNL. Included are: (1) a discussion of the features and functions of each of several concepts; (2) conceptual layout drawings; (3) comparison of advantages and disadvantages of the concepts; (4) functional-flow block diagrams and requirement allocation sheets; and (5) an evaluation and rating sheet for each concept. The concepts that best meet the requirements of the FFTF fuel handling and radioactive maintenance systems are recommended. (auth)

24710 (TID/SNA-365) CONCEPTUAL DESIGN REQUIREMENTS IRRADIATED FUEL HANDLING EQUIPMENT FOR THE FAST FLUX TEST FACILITY, HANFORD WORKS, RICHLAND, Washington. Revision I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. Contract AT(04-3)-782. 48p. Dep. NTIS $5.50.

Design standards for irradiated fuel remote handling equipment at FFTF are presented. (JWR)

24711 (TUBIK-33) DETERMINATION OF THE TEMPERATURE COEFFICIENT OF ηf IN A FUEL UNIT CELL OF THE BER II. Badur, A.; Schwarzer, K.; Memmert, G. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Aug 1974. 77p. (In German). Dep. NTIS (US Sales Only) $7.00.

For the reactor BER (Berliner-Experimental-Reaktor) the temperature coefficient is calculated as a function of the temperature of the fuel rod. Here the temperature is assumed as constant or of parabolic shape. The scattering of neutrons in the thermal energy region is determined by the Nelkin-model for ZrH or by Nelkin-model for Water and H as a free gas. This comparison shows the influence of the scattering model on the temperature-coefficient. Comparisons between consistent calculations with isotropic (transport theoretical approximation) and real anisotropic scattering were made. The results are: (1) the temperature distribution in the fuel rod has a small influence on the temperature-coefficient; (2) the temperature-coefficient using a scattering model for ZrH is smaller than that for H_2O or H (free gas); and (3) the effect of anisotropy is negligible. (auth)

24712 (TUBIK-34) DETERMINATION OF THE EFFECTIVE CROSS SECTIONS FOR CONTROL, ROD FOLLOWER, AND GRAPHITE ELEMENTS OF A UZrH CORE. Doehler, J.; Schneider, K. U.; Bartsch, G. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Aug 1974. 62p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

Cross sections for the fuel, graphite and control elements (with and without the control rod) of the BER-II-core are determined. Models of homogeneous cells are constructed in which the respective elements are surrounded by a characteristic and homogeneous ring of fuel-coolant mixture, the ring being of varying thickness. By means of different computer programs in the thermal and fast energy ranges the cross sections of these standard cells were computed for one thermal and three fast energy groups. The dependence of these cross sections on the thickness of the surrounding ring is discussed. (auth)

24713 (WANL-TME-1638) DESIGN MANUAL AND SAFETY ANALYSIS FOR EXPERIMENT RE-4, NUCLEAR HEATING MEASUREMENT. Burwell, D. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Jul 1967. 38p. Dep. NTIS $5.00.

The purpose of this experiment is to measure the nuclear heating spatial distribution in HT-1 of the Plum Brook reactor using aluminum cylindrical calorimeters. Three calorimeters will be located along a horizontal line perpendicular to the core vertical surface and intersecting the HT-1 axis. The assembly containing these three calorimeters will be moved to various distances from the full-in position to determine heating distribution along the HT-1 axis. (auth)

24714 PRESSURE PULSE ON A SUBASSEMBLY WALL DUE TO GAS RELEASE FROM A FAILED FUEL PIN. Chang, L. K.; Golden, G. H.; Judd, A. M.; Koenig, J. F. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 31: No. 1, 72-76(Nov 1974).

A mathematical model is described for predicting the pressure pulse on a subassembly of fuel pins due to rapid release of gas from a failed pin into liquid coolant between the pins. The subassembly is simulated by a rigid circular tube, and liquid flow inside the tube is assumed incompressible, inviscid, and irrotational. A gas bubble along the centerline of the subassembly is considered to be formed as a result of the gas release from the plenum, and a pressure pulse on the subassembly wall is a consequence of the liquid being accelerated by the gas bubble. It is assumed that the gas bubble grows spherically until it touches the subassembly wall, and then expands as a cylinder with hemispherical ends. This analysis is particularly applicable to the EBR-II reactor. (auth)

24715 THERMAL TRANSIENT SIMULATION TESTS OF A SODIUM VALVE. Cho, S. M.; DeMuri, R. J. (Atomics International, Canoga Park, Calif. (USA). Liquid Metal Engineering Center). Nucl. Eng. Des.; 31: No. 1, 31-45(Nov 1974).

The feasibility of thermal transient testing of sodium components using a fluid other than sodium is considered. Simulation of thermal transient conditions that may exist in the sodium system is considered to be, in general, achievable in a special test fixture, if the thermal and hydraulic conditions of the fluid to be used are properly selected. This feasibility is demonstrated for the 28 in. FFTF hot-let isolation valve by introducing a high-speed gaseous nitrogen flow into an annulus formed by the valve body and a cylindrical pipe insert. The structural wall temperature distributions were estimated first for the sodium system, and the simulation was established by equating the transient heat transfer rates as a function of time at key locations in both real sodium and simulating nitrogen systems. Remarkably good simulation test results were achieved. (auth)

24716 SLOWPOKE AT THE UNIVERSITY OF TORONTO: THREE YEARS OF PROGRESS. Jervis, R. E. (Univ. of Toronto); Hilborn, J. W.; Kay, R. E.; Hancock, R. G. V. pp Paper 205, 15p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 2. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

SLOWPOKE-1 reactor is a 20 kW critical assembly at the University of Toronto. It was designed by Atomic Energy of Canada Limited. SLOWPOKE is a pool reactor containing a highly enriched ^{235}U-Al core surrounded by a beryllium reflector. The reactor is controlled by a single absorber rod driven by a motor activated by a controller responding to a signal from a self-powered neutron detector. The only shutdown system needed is an on–off switch, and SLOWPOKE can safely be left on at night unattended. With reactivity adjustments every 6 months, the core will last 10 years at 1,000 kWh per month. The few minor malfunctions that have occurred are mentioned. Various graduate and undergraduate uses mentioned include activation analyses and the production of ^{18}F, ^{42}K and ^{24}Na. (CA)

24717 CFRMF NEUTRON FIELD FLUX SPECTRAL CHARACTERIZATION. Rogers, J. W.; Millsap, D. A.; Harker, Y. D. (Aerojet Nuclear Co., Idaho Falls, ID). Nucl. Technol.; 25: No. 2, 330-348(Feb 1975).

The Coupled Fast Reactivity Measurements Facility (CFRMF) is a zoned-core critical assembly with a fast-neutron spectrum zone in the center of an enriched ^{235}U, water-moderated thermal "driver" zone. The neutron spectrum of the fast zone has a mean energy of ~0.72 MeV with an energy distribution of interest in fast breeder reactor dosimetry and reaction rate studies. The CFRMF neutron field has become one of the standard spectra for testing fast-neutron reactions in fissile and nonfissile materials in an interlaboratory experimental effort. The CFRMF has found much use as a fast-neutron field for the activation of materials of interest in the fast breeder reactor programs because of its well-studied energy spectrum and spatial gradients, intensity [up to 10^{11} n/(cm^2 sec)], the precise control and reproducibility of intensity and experimental amenabilities. The neutron energy spectrum at the core center has been measured by proton-recoil spectrometry between ~3.0 keV and ~2.5 MeV and calculated by resonance absorption, transport theory, and Monte Carlo multigroup techniques from 10 MeV down. Neutron flux distributions in the fast zone have been examined by activation and fission rate measurements which show that gradients do not exceed ~0.3% in the region where the experiments are located. (20 references) (auth)

24718 ANALYSIS OF BURNUPS IN EBR-II DRIVER-FUEL ELEMENTS. Meneghetti, D.; Ebersole, E. R.; Walker, P. (Argonne National Lab., IL). Nucl. Technol.; 25: No. 2, 406-415(Feb 1975).

Measured burnup values of about 100 enriched-uranium driver-fuel elements irradiated in the Experimental Breeder Reactor II are compared with calculated values based on run-to-run subassembly-delineated transport analyses. These elements have burnups in the range of 0.3 to 1.6 at.%. The scatter of the ratios of calculated-to-measured burnups indicates that the composite precision with which measurements and calculations can be compared using current methods is from about ±5 to 10%. (12 references) (auth)

24719 ANALYSIS OF DOSIMETRY MEASUREMENTS IN EBR-II. Sehgal, B. R.; Rempert, R. H. (Argonne National Lab., IL). Nucl. Technol.; 25: No. 2, 390-405(Feb 1975).

Analyses of an extensive series of reaction-rate measurements done recently in the Experimental Breeder Reactor II (EBR-II) runs 50G and 50H were performed with transport theory and diffusion theory codes using detailed representations of the loadings in XY, RZ, and XYZ geometry and broad-group cross sections derived from the ENDF/B-I and -III data files. It was found possible to predict the measured relative reaction rates quite accurately within the core region; however, there are substantial differences in the radial blanket and axial reflector regions. Analyses of the absolute reaction-rate measurements in EBR-II run 50H have provided additional evidence that the reactor operates ≅ 9% below the nominal power level of 62.5 MW(t). Differences were observed between the calculated reaction rates using the ENDF/B-I and -III data files for the stainless-steel/sodium axial reflector regions in the EBR-II. (11 references) (auth)

24720 CENTRAL NEUTRON SPECTRUM OF THE FAST CRITICAL ASSEMBLY BIG-TEN. Dowdy, E. J. (Los Alamos Scientific Lab., NM); Lozito, E. J.; Plassmann, E. A. Nucl. Technol.; 25: No. 2, 381-389(Feb 1975).

The BIG-TEN critical assembly at the Los Alamos Scientific Critical Experiments Facility was designed to provide a neutron spectrum somewhat like that expected in the liquid-metal fast breeder reactor. The relatively uncomplicated configuration of this assembly makes it useful for comparison of measured and calculated neutronic characteristics, and the high precision reproducibility of reactivity makes it valuable for intercomparisons of reaction rates. The central neutron spectrum was measured using proton-recoil proportional-counting techniques with pulse shape discrimination capability for the energy range from 27 to 1200 keV. (9 references) (auth)

24721 SECONDARY INTERMEDIATE-ENERGY STANDARD NEUTRON FIELD AT THE MOL-ΣΣ FACILITY. Fabry, A.; De Leeuw, G.; De Leeuw, S. (CEN, Mol, Belgium). Nucl. Technol.; 25: No. 2, 349-375(Feb 1975).

The value and usefulness of the concept of the intermediate-energy standard neutron field has been recognized by a number of international experts including the European-American Committee for Reactor Physics and Euratom Working Group on Reactor Dosimetry. In 1969, the MOL-ΣΣ facility was proposed and in the early spring of 1970 was put into operation. It was selected as one of the five benchmarks for a place to test the ENDF/B Dosimetry File as well as one of the IAEA benchmarks for validation of nuclear data for reactor neutron dosimetry. ΣΣ is a thermal fast-coupled spherical source assembly located within a conventional graphite thermal column. Geometrical data and major radiation field parameters are well defined. The MOL-ΣΣ secondary intermediate-energy standard neutron field has met all the requirements to make it suitable for high-accuracy interlaboratory comparisons and standardizations of the major techniques applied in zero-power fast assemblies and in fuels dosimetry. ΣΣ central reaction rates and ratios have been measured and compared to theoretical predictions. (43 references) (auth)

24722 INVESTIGATION OF THE FLUORINE-17 ACTIVITY AS A NUCLEAR POWER MONITOR IN THE HEAVY WATER MODERATED REACTOR DIORIT. Behringer, K.; Leoni, B.; Pruys, H. S. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Nucl. Technol.; 25: No. 3, 572-575(Mar 1975).

In the D_2O moderator of a reactor, a significant ^{17}F activity is produced by the reaction ^{16}O(d,n)^{17}F with recoiling deuterons. Investigations in the DIORIT reactor have shown that this activity can be used within certain limits to monitor the nuclear power. (auth)

24723 CONCEPTUAL DESIGN OF A FAST SUBCRITICAL BLANKET FACILITY. Krauss, F. G.; Ott, K. O.; Clikeman, F. M. (Purdue Univ., West Lafayette, IN). Nucl. Technol.; 25: No. 3, 429-439(Mar 1975).

The basic neutron physics investigations and the conceptual design of a cylindrical fast subcritical facility for investigating the properties of fast reactor blankets have been completed. The Department of Nuclear Engineering at Purdue University plans to construct this facility to enable students to carry out studies in fast reactor blankets and reflectors. Fast neutron flux spectra in this facility can be made very similar to the spectra anticipated in the blanket of either a typical large liquid-metal or gas-cooled fast breeder reactor. Fast neutron spectra, spatial flux distributions, plutonium production rates, neutron transmission, and other physics parameters of typical fast reactor blanket designs can be investigated with this facility. The results can be used to refine the analysis and to improve the designs of blankets and structures outside the blankets in future fast breeder reactors. (auth)

24724 CHARACTERISTICS OF PULSED FAST NEUTRON-TO-GAMMA-RAY CONVERTERS. Kazi, A. H.; Dunn, T. A.; Harrison, R. C.; Williams, D. O. (Army Ballistic Research Labs., Aberdeen Proving Ground, MD). Nucl. Technol.; 25: No. 3, 450-463(Mar 1975).

The Army Pulse Radiation Facility Reactor is a fast pulse, or burst, reactor generally used to provide a fast neutron environment. In response to several test requirements, a number of fast neutron-to-gamma converter shields have been designed, calibrated, and placed into operation to produce a pulsed or steady-state gamma environment of ionizing radiation. The four basic converter configurations are (a) a narrow pulse converter box which has produced a maximum gamma dose rate of 3.8×10^8 rad/sec with a pulse width at half-maximum power of 50 μsec; (b) a wide pulse converter box which has produced 6.7×10^7 rad/sec at 400 μsec; (c) a narrow pulse converter cavity that has produced 7.7×10^9 rad/sec at 50 μsec; and (d) a wide pulse converter cavity that has produced 7.7×10^7 rad/sec at 1 msec. In terms of rads tissue, the gamma-to-neutron dose ratio varies from 0.1 (no converter) to ~5; while in terms of rads (silicon), the neutron dose is almost 2 orders of magnitude less than the gamma dose. (auth)

24725 MONITORING FISSION GAS IN EBR-II BY HIGH-RESOLUTION GAMMA SPECTROMETRY. Brunson, G. S. (Argonne National Lab., Idaho Falls, ID). Nucl. Technol.; 25: No. 3, 553-571(Mar 1975).

High-resolution gamma spectrometry is routinely performed for fission product gases in Experimental Breeder Reactor II as

a means of detecting and identifying fuel elements with leaks in the cladding. Detailed data accumulated for more than two years of operation has established background concentrations as well as the behavior of these fission products from eight different fuel elements. Different types of fuel have different "fingerprints." It appears quite easy to distinguish a carbide leaker from either metal or oxide. The distinction between oxide and metal is less clear cut, but results indicate that identification can be made with some confidence on the magnitude of the signal and on isotopic ratios, particularly the ratio $^{85}Kr/^{133}Xe$. Further analysis has been made of the ^{22}Ne activation rate, which is expected to be much higher and far more troublesome in future sodium-cooled fast reactors. (auth)

24726 CORRELATION OF TRANSIENT-TEST DATA WITH CONVENTIONAL MECHANICAL PROPERTIES DATA. Straalsund, J. L.; Fish, R. L.; Johnson, G. D. (Hanford Engineering Development Lab., Richland, WA). Contract AT(45-0)-2170. Nucl. Technol.; 25: No. 3, 531-540(Mar 1975).

Thermal transient-test failure data for prototypic fast test reactor fuel cladding were correlated with failure data from conventional mechanical properties tests. The correlation was developed by the application of a life fraction rule to stress rupture, tensile and tube burst, as well as transient test data and by constructing a Larson-Miller plot which encompasses the stress and temperature range for all types of tests. The high degree of correlation between the different types of test data indicates that this approach will be useful in the prediction of failures under hypothetical transient conditions. It is shown that the Dorn parameter can be used instead of the Larson-Miller parameter with equal success for the various types of mechanical properties tests. (auth)

24727 FAST-THERMAL CRITICAL ASSEMBLIES OF THE INSTITUTE OF NUCLEAR POWER ENGINEERING OF THE ACADEMY OF SCIENCES OF THE BSSR. Grusha, N. M.; Evchukh, A. I.; Serafimovich, I. G.; Churkin, Yu. I.; Yaroshevich, O. I. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 1, 20-23(1974). (In Russian).

The fast-thermal critical assemblies are described. A presentation is given of nuclear concentrations of materials in the active zone, the results of calculating neutron spectra in the fast zone of BTS-2 critical assemblies, and the character of experiments which are planned. (tr-auth)

Production and Materials Testing and Processing Reactors

24728 N REACTOR FUEL ELEMENT IMPROVEMENT PROGRAM: A SYSTEMS APPROACH. Leitz, E. E. (United Nuclear Industries, Inc., Richland, WA). pp 550-557 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Late in 1971 it was concluded that the fuel performance at the N Reactor at Richland, Washington, merited increased emphasis to identify and reduce fuel failure causes (metallic uranium fuel elements). In response, a Fuel Systems Analysis Task Force was formed in January of 1972 and was assigned the responsibility for the evaluation of all United Nuclear Industries' operations affecting fuel performance. The Task Force was responsible for developing short- and long-term activities to improve fuel performance. An explanation is presented on how the systems approach was used to evaluate United Nuclear Industries' operations affecting fuel performance (fuel manufacturing, fuel handling, and fuel irradiation) and then how systems management (project matrix-type management) was used to coordinate implementation of the short and intermediate programs developed by the Task Force. The fuel performance during the fiscal year the Task Force's programs were being implemented improved very significantly. Although the data are too limited at this time to draw a final conclusion, it is estimated the fuel failure rate has been cut by at least a factor of two and very likely by a factor of 10. It is significant that no fuel elements have failed of those which were charged after implementation of the intermediate program during the summer of 1972. (auth)

24729 COMBINED NUCLEAR AND HYDROGEN ENERGY ECONOMY: A LONG TERM SOLUTION TO THE WORLD'S ENERGY PROBLEM. Booth, L. A.; Balcomb, J. D.; Edeskuty, F. J. (Los Alamos Scientific Lab., NM). pp 396-403 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Hydrogen, which is virtually inexhaustable in the form of water, could be substituted for natural gas and petroleum-based fuels for industrial and residential heating and for transportation. Nuclear energy, either fusion or fission, would be the primary energy source. Thermal energy from the nuclear heat source would be converted to electrical energy in a conventional heat-engine cycle. Hydrogen could be produced from water by a cyclic thermochemical process. Gaseous hydrogen for industrial and residential heat would be transported in a high-pressure pipeline system. Liquid hydrogen stored in metal hydrides could be used for transportation fuels. The basis of this future energy economy would be energy complexes of two types. Large plants, located off-shore would produce hydrogen and electricity with desalted water as a byproduct. Smaller plants, located inland near urban centers, would produce primarily electricity and hydrogen. (21 references) (auth)

24730 NUCLEAR PROCESS HEAT PROGRAMS IN GERMANY. Harder, H. (Hochtemperatur-Reaktorbau GmbH, Mannheim, Ger.); Fischer, R. Nucl. News; 4: No. 4, 56-62(Mar 1975).

The development programs for coal gasification and liquefaction in the Federal Republic of Germany are reviewed, and the two gasification processes, hydrogasification and steam gasification, are described. Investigations are underway on the problems of coupling a high temperature pebble bed reactor to such processes. The industrial firms involved, the experimental plants, reactor development problems, and coal gasification processes for future development are briefly described. (HDR)

Propulsion and Package Reactors

Refer also to abstracts 22387, 22391–22422, 22539, 22552, 22822–22824, 22826, 23157, 23161, 23209–23218, 23254, 23261, 23360, 24948, 25031–25033, 25115, and 25119.

24731 (AGC-1157) CONTINUED INVESTIGATION OF NUCLEAR ROCKETS. Work Program Report. (Aerojet-General Corp., Azusa, Calif. (USA)). 31 Jul 1956. 97p. Dep. NTIS $8.00.

Declassified 14 Feb 1969.

Research is described for space propulsion reactor kinetics, components, and materials. (DCC)

24732 (AGC-1164) DEVELOPMENT OF A NUCLEAR ROCKET. 5-Year-Program Outline. (Aerojet-General Corp., Azusa, Calif. (USA)). 15 Aug 1956. Contract AF 33(616)-3767. 57p. Dep. NTIS $6.00.

Declassified 12 May 1969.

A 5-year program leading toward the development of a nuclear rocket is presented. The program is based on completion, by the end of the 5-year period, of a complete full-scale developmental propulsion system, ready for testing, together with design criteria and the preliminary design of a prototype propulsion system. The philosophy which has been adopted as a basis for the program is that extensive experience may be gained from the development of a small-scale, non-flyable, nuclear-rocket system. Such a system has the advantage of being less costly and less time-consuming to build. Furthermore, many of the problems of the full-scale system, such as start-up, shutdown, and control during operation can be studied to advantage with the smaller power plant. The program is also based on the assumption that the reactor programs presently conducted by the National Laboratories will progress sufficiently to provide adequate information for the design of the prototype reactor and components, particularly the controls, for the prototype propulsion system, and that one or more reactors will be available from the current reactor program for use with the small-scale propulsion system. (auth)

24733 (AGC-2469(Rev.D)) RELIABILITY AND QUALITY ASSURANCE PROGRAM PLAN FOR NERVA ENGINE SYSTEM. Revision D. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1968. 130p. Dep. NTIS $9.50.

The reliability and quality assurance program plans are based on the integration and coordination of the many activities that affect the reliability of a given end product. These activities pertain to the system, subsystem, assembly, subassembly, component and part level, and include analytical, preliminary design, fabrication, procurement, processing, maintenance, test, etc., until the end item has been disposed of in the prescribed manner. These program plans also will provide for the early and prompt detection of actual or potential deficiencies, system incompatibility, mar-

ginal quality and trends or conditions that could result in degradation of quality or reliability and will ensure timely and effective corrective action of all such conditions. (auth)

24734 (AGC-2516) NRX OPERATIONAL SUPPORT PLANS. Preliminary Draft. (Aerojet-General Corp., Azusa, Calif. (USA)). Apr 1963. 235p. Dep. NTIS $14.75.

The Operational Support Plan identifies specific items of equipment required to support the NERVA NRX program in each operating area through a systematic review and analysis of basic criteria such as the NRX system test, plans, propulsion requirements, operational flow plans, reactor design and facility interfaces. The support equipment referred to includes special equipment or devices required to inspect, test, service, calibrate, assemble, disassemble, post mortem, transport, safe-guard, actuate, install, control, handle, maintain and dispose the NERVA NRX system, subsystem and components. The Provisioning List and Schedule documents identify each end item of support equipment to be provided by subcontractors, for which requirements are established within the associated NRX Operational Support Plan. (auth)

24735 (AGC-2520) NERVA POST-OPERATIVE REQUIREMENTS AND SUPPORT SYSTEM UTILIZATION. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1963. 140p. Dep. NTIS $10.00.

Post-operative tests and examinations are one of the most valuable assets in engine development programs, as the data obtained through these analyses either confirm design predictions or provide data for design changes. The NERVA engine development, like all engine development programs, requires post-operative testing and examination. However, since the NERVA engine is a nuclear engine and will be the first program to combine the reactor with the engine systems, the facilities for conducting the post-operative analyses will be somewhat unique. The need for a unique facility for the NERVA engine post-operative testing and examination has been recognized and the Vitro Engineering Company prepared a conceptional design and provided the design criteria for a nuclear rocket engine maintenance assembly and disassembly facility (E-MAD). This facility design was based upon the operational requirements of the NERVA engine established by the Aerojet-General Corporation and is under construction. The post-operative test requirements for the NERVA engine program include descriptions of the tests, the concept for the test program and test sequence, descriptions of the support systems required to implement the program, and a safety summary. The data illustrate the requirements for the post-operative analyses which justify the requirements for the testing facility, and the necessary equipment to support the NERVA development program. (auth)

24736 (AGC-2551) EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO HYDROGEN AT NEAR CRITICAL TEMPERATURES AND SUPERCRITICAL PRESSURES FLOW TURBULENTLY IN STRAIGHT AND CURVED TUBES. (Aerojet-General Corp., Azusa, Calif. (USA)). May 1963. 302p. Dep. NTIS $18.25.

An experimental non-burnout study of heat transfer to hydrogen at near-critical temperatures flowing turbulently in resistance-heated straight and curved channels was made to evaluate the applicability of earlier heat transfer correlations to nozzle design. Coolant passage geometry was simulated by bending stainless-steel test sections to a contour typical of a rocket nozzle throat. The fluid was heated asymmetrically by chemically-milling the tube wall to reduce the metal thickness on one side. Heat fluxes up to 14.5 Btu/in.^{2}sec and wall-to-bulk temperature ratios up to 18.5 were achieved. Correlating equations were generated for the straight and curved tube geometries with fluid properties evaluated at the bulk temperature. However, analysis of the data indicates this simple correlation approach does not adequately express the data. A comparison of these equations with earlier correlations showed that the equation generated from straight tube tests was the most conservative and that generated from curved tube data was in general the most optimistic. (auth)

24737 (AGC-2894) NERVA H-ZONE HAZARD STUDY. Booth, S. H. (Aetron, Covina, Calif. (USA)). Jul 1964. 80p. Dep. NTIS $7.00.

The nonnuclear hazards at test facilities due to spilled gaseous or liquid hydrogen released by malfunctions, other explosions, etc. and mixed with air or possibly liquid oxygen are considered. The TNT equivalent of spilled propellants depends on many factors but, for calculations, is based on 60 percent of the total propellants spilled in 5 seconds. This is regarded as conservative, and is further reduced by a poor mixing factor when large quantities are involved. The worst case considered involves a preliminary blast caused by a thrust chamber test malfunction releasing 200,000 lbs. of liquid hydrogen which then explodes with a blast equivalent to 30,000 lbs. of TNT. All buildings which would contain personnel during testing or other hazardous operations have been designed to withstand overpressures from an explosion of this magnitude and keep blast-overpressure inside below the 5 psi eardrum rupture threshold. In many cases of leaks, fires are more likely than explosions. Various safety procedures are outlined: distances between storage vessels, relief valves, redundant valving, gravel-filled LH_2 boil-off pits under vessels, automatic malfunction control devices, hydrogen detection and water deluge systems. (LTN)

24738 (AGC-7410-0593) NERVA FLIGHT PROGRAM REQUIREMENT ALLOCATION SHEETS, FULL FLOW ENGINE (REFERENCE DRAWING 1136390-A). (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Mar 1970. 489p. Dep. NTIS $27.50.

The operational support concepts for the NERVA Flight Program have been summarized in the form of Functional Flow Diagrams and more than 450 Requirement Allocation Sheets involving specific tasks or requirements to be carried out. The planning supports the Full Flow NERVA Engine identified on AGC Drawing 1137101 and shown pictorially on AGC drawings 1136390 and 1136391. (LTN)

24739 (AGC-7850-0203) NERVA RELIABILITY PROGRAM SUMMARY. Status Report Prepared for AEC–NASA Space Nuclear Propulsion Office. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1969. 203p. Dep. NTIS $13.25.

Reports of reliability analyses conducted in the past quarter are documented. A list of current trade studies is included, along with the interactions of reliability engineering with such trade studies. (LTN)

24740 (AGC-8771-2349) ENVIRONMENTAL EVALUATION TESTING OF NERVA NRXA-2HF INSTRUMENTATION. Felter, M. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1964. 87p. Dep. NTIS $7.50.

Engineering evaluation tests were conducted on candidate instrumentation for Nuclear Reactor Experimental A-2 Hot Flow (NRXA-2HF) tests. This instrumentation consisted of: Clevite Piezoelectric accelerometers, Consolidated Controls Corp., and Physical Science Corp. Linear Variable Differential Transformer (LVDT) type pressure transducers, Servonics potentiometric pressure transducers, Microdot bonded strain gages, and Aerojet-General Corporation Tungsten/Tungsten 25% Rhenium (W/W-25% Re) thermocouples. Tests included: temperature shock and acoustical for accelerometers, dynamic response and vibration sensitivity for LVDT and potentiometric pressure transducers, high temperature vibration for W/W-25% Re thermocouples, and cantilever beam strain tests for Microdot bonded strain gages. While most instruments performed satisfactorily, some were sensitive to vibration, some to gamma heating, and residual oil in some instruments froze at cryogenic temperatures. (auth)

24741 (AN-SFP-25) SFP PROPOSAL OUTLINE. (Aerojet-General Corp., Azusa, Calif. (USA)). 4 Jan 1961. 8p. Dep. NTIS $4.00.

Declassified 18 Dec 1969.

A proposal for the production of fuel elements of graphite loaded with uranium involves mixing (graphite, lamp black, UO_2, and a binder), extruding, curing, baking, machining and coating. Quality control methods and plant design are discussed briefly. (LTN)

24742 (ANSC-APS05-A035) ADVANCED PROPULSION SURVEY. Vanica, D. F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 87p. Dep. NTIS $7.50.

Advanced propulsion systems (gaseous core, colloid core, electric, controlled thermonuclear, and high-energy chemical) are reviewed on the basis of performance potential and the status of current technology. In addition, a possible development program for each system is presented. (71 references) (auth)

24743 (GA-7759) RESEARCH AND DEVELOPMENT ON FISSION-HEATED THERMIONIC CELLS FOR APPLICATION TO NUCLEAR SPACE POWER SYSTEMS. Summary Report, October 1, 1966–September 30, 1967. (Gulf General Atomic Co., San Diego, Calif. (USA)). 27 Oct 1967. Contract AT(04-3)-167. 81p. Dep. NTIS $7.25.

Declassified 5 Mar 1975.

Work conducted towards the development of a nuclear thermionic reactor is reported. Major tasks in the program included materials technology, thermionic cell and fuel element development, and nuclear technology. (JWR)

24744 (GEMP-307) DOPPLER COEFFICIENT CALCULATIONS FOR A FAST SPECTRUM REFRACTORY-METAL REACTOR AND ANALYSIS OF THE 710 STUDY MODEL. Prince, A.

(General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 1 Jun 1964. Contract AT(40-1)-2847. 131p. Dep. NTIS $9.75.

Declassified 3 Mar 1975.

The Doppler temperature coefficient of reactivity in a fast spectrum, refractory-metal reactor (710 study model) was computed. The method of calculation is primarily the same as that outlined by Nicholson prompted by the original formulations of Goertzel, Lane and Bethe. With the aid of existing low-energy experimental data, a comprehensive analysis was performed to determine the resonance parameters and related data in the high-energy region where no experimental information exists. These results were then used in a reactor perturbation calculation employing multigroup cross sections to determine the individual contribution of each of the core isotopes to the reactivity change that results from Doppler broadening in the unresolved resonance region. This calculational method takes into consideration the spatial variation of the neutron flux, importance, isotopic concentration, and the variation in the effective cross sections of each individual isotope both in energy and temperature. The Doppler coefficient, due to the capturing isotopes of tungsten (W^{182}, W^{183}, W^{184}, W^{186}), Ta^{181}, and U^{238}, all proved to be negative while the fissile isotope U^{235} contributed a positive coefficient over all energies and temperatures. The reactivity loss $\Delta k/k$ is 0.458 percent at 3880°F (the operating temperature). Intermediate calculations performed also produced theoretical values of the partial capture and fission cross sections for both s and p wave neutrons of the contributing isotopes. (auth)

24745 (LA-3214-MS) PARTICLE SIZE DISTRIBUTION FROM A ONE-NINTH-SCALE ROVER REACTOR AXIAL-HE DESTRUCT. Campbell, E. E.; Ide, H. M.; Moss, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 15 Dec 1964. Contract W-7405-eng-36. 49p. Dep. NTIS $5.50.

Declassified 29 Aug 1973.

Thirty-three Rover type fuel elements, representing a scaled down volume of a Kiwi reactor, weighed 2955.5 g and were fragmented by 49 g of high explosives. The particle size distribution and particle characteristics were determined. The mass median particle diameter was 1125 μ. One-third of all beaded fuel was freed as individual uranium carbide beads. Various methods of analysis and interpretation are given. (auth)

24746 (LA-3337-MS) KIWI TNT PARTICLE STUDY. Campbell, E. E. (Comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Aug 1965. Contract W-7405-eng-36. 162p. Dep. NTIS $11.25.

Declassified 28 Aug 1973.

Particle data accumulated from the Kiwi Transient Nuclear Test (Kiwi TNT) are presented. The methods of sampling for airborne particulate and ground deposited debris are discussed in detail. An evaluation of the procedures used is included. Analysis of the data obtained is discussed and includes mass and count particle size distribution, particle character, and fission product and uranium distribution within individual particles. The data from each study are related to the entire reactor breakup. (auth)

24747 (LA-3506-MS) AFTERHEATER REACTOR STUDY. Newman, H. J.; Sapir, L. J.; Gido, R. G.; Rose, D. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 10 Feb 1966. Contract W-7405-eng-36. 128p. Dep. NTIS $9.50.

Declassified 28 Aug 1973.

The concept of afterheaters for graphite reactors in which the afterheater has fuel material capable of higher temperatures than those reached by graphite fuels is investigated. Performance is compared to that of graphite reactors. (auth)

24748 (N-74-32104) ADVANCED DESIGN CONCEPTS IN NUCLEAR ELECTRIC PROPULSION. Peelgren, M. L.; Mondt, J. F. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1974. Contract NAS7-100. 90p. (NASA-CR-139635; JPL-TM-33-664). NTIS $7.50.

Conceptual designs of the nuclear propulsion programs are reported. Major areas of investigation were (1) design efforts on spacecraft configuration and heat rejection subsystem, (2) high-voltage thermionic reactor concepts, and (3) dual-mode spacecraft configuration study. (auth)

24749 (N-74-32105) NUCLEAR ELECTRIC PROPULSION STAGE REQUIREMENTS AND DESCRIPTION. Mondt, J. F.; Peelgren, M. L.; Nakashima, A. M.; Nsieh, T. M.; Phillips, W. M.; Kikin, G. M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1974. Contract NAS7-100. 71p. (NASA-CR-139636; JPL-TM-33-647). NTIS $6.75.

The application of a nuclear electric propulsion (NEP) stage in the exploration of near-earth, cometary, and planetary space was discussed. The NEP stage is powered by a liquid-metal-cooled, fast spectrum thermionic reactor capable of providing 120 kW(e) for 20,000 hours. This power is used to drive a number of mercury ion bombardment thrusters with specific impulse in the range of 4000-5000 seconds. The NEP description, characteristics, and functional requirements are discussed. These requirements are based on a set of five coordinate missions, which are described in detail. These five missions are a representative part of a larger set of missions used as a basic for an advanced propulsion comparison study. Additionally, the NEP stage development plan and test program is outlined and a schedule presented. (auth)

24750 (NDS-18) FEASIBILITY STUDY: DUAL USE OF A NUCLEAR ENGINE, PROPULSION/ELECTRICAL POWER GENERATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Jun 1969. 13p. Dep. NTIS $4.00.

A preliminary study is made of the feasibility of using a NERVA reactor as a heat source to generate electricity for other needs in flight. The amount of power specified is 25 kWe, which would require 100 to 500 kWt, depending on the efficiency. This would be only 0.2 to 1.0 percent of total NERVA requirements (even for up to eight years), so the heat energy could be available unless other reactor problems develop from such use. The problems of converting this heat into electricity with a reliable system are discussed in a preliminary way with the suggestion that SNAP systems be studied, the required NERVA modifications investigated (especially with respect to possible problems) and that interface, control and reliability studies be made. (LTN)

24751 (NJD-16) XE-2 OPERATING LIMITS DOCUMENT, PHASE IA. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1968. 11p. Dep. NTIS $4.00.

The constraints are defined within which XE-2 assembly operations, up to, but not including, central poison wire removal are to be accomplished at the E-MAD Facility at the Nuclear Rocket Development Station (NRDS). These operations include Receiving and Inspection of XE-2 components, Mechanical and Electrical Assembly of the Engine and Peripheral Poison Wire Removal. The operating limits contained herein specify the administrative and technical boundaries within which the Phase IA Assembly Operations will be performed. Management Controls define the administrative limits and include the required documentation and the documentation approval mechanism. Operational Controls define the boundaries, procedural safeguards and operating safety limits within which operations will be completed. (auth)

24752 (NJD-0027) NOZZLE CHAMBER TEMPERATURE MEASUREMENT REQUIREMENTS AND MEASUREMENT SYSTEM STUDIES. Samuelson, R. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 98p. Dep. NTIS $8.00.

The problem of making nozzle chamber temperature measurements with sufficient accuracy to calculate precise values of thrust and specific impulse is discussed in detail. Part of the problem is the uncertainty about the equation relating nozzle flow and specific impulse but, in addition, there are very real problems in measuring such temperatures accurately. Several recommendations are made. (LTN)

24753 (NTO-R-0074) FACILITY CHECKOUT REPORT FOR NRX-A5 TEST SERIES. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 20 May 1966. 83p. Dep. NTIS $7.25.

The NRX-A5 Facility Checkout test was successfully performed on May 12, 1966 at the Test Cell "A" facilities. Significant operations were: Checkout of the facility turbopump and cryogenic piping; checkout of the LH_2 flow control systems; checkout of the fixed drum flow profile; operator training; and obtaining of data to evaluate the performance of the scram flow decay system. The overall performance of the tests was successful and considerable information was obtained in spite of several operational problems. The performance of the turbopump and cryogenic system piping was as expected and the limited data obtained on the PCV-41 Pressure Controller indicated its performance was satisfactory. The data obtained on the Scram Flow Decay System indicated that the system performance would not meet the new requirements specified by WANL. Additional tests are planned along with some system modifications. Many secondary type objectives of the tests were obtained and considerable facility performance data was gathered. (auth)

24754 (RN-64005A(Folder 1)) GASEOUS CORE REACTOR ANALYSIS (FOLDER 1). A Proposal to Lewis Research Laboratory. (Aerojet-General Corp., Azusa, Calif. (USA)). 25 May 1964. 72p. Dep. NTIS $6.75.

A proposal is submitted for the use of computers to analyze the possibilities of gaseous-fueled cavity reactors for nuclear propulsion. The proposed calculations are outlined and calcula-

tions on other reactors, for which experimental data were available, are presented as proof of ability to carry out such calculations expeditiously and accurately. (LTN)

24755 (RN-64005A(Folder 2)) GASEOUS CORE REACTOR ANALYSIS (FOLDER 2). A Proposal to Lewis Research Laboratory. (Aerojet-General Corp., Azusa, Calif. (USA)). 25 May 1964. 25p. Dep. NTIS $4.25.

This proposal outlines costs, contract terms and conditions for performing analytical services set forth in the suggested Statement of Work to be included in any resultant contract. The goal of the proposed program is to provide NASA with analytical assistance in support of studies on a gaseous, fuel-cavity reactor for nuclear propulsion. (auth)

24756 (RN-70003) PROPOSAL FOR THE DESIGN, DEVELOPMENT, AND APPLICATION OF LH_2 HYDROSTATIC RADIAL BEARINGS FOR A PROTOTYPE TURBOPUMP FOR NERVA APPLICATION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 3 Apr 1970. 75p. Dep. NTIS $6.75.

A proposal is presented for the design and development of Liquid Hydrogen Hydrostatic Radial Bearings for application in a prototype NERVA turbopump. Once a bearing of this type is operational on its fluid film, wear from rubbing contact is eliminated except for off-design or malfunction-induced rubs. But some method (and three are proposed) of overcoming the transient start/stop problems is required. Some recent test results with such bearings are reviewed and the proposed program is developed in detail. (LTN)

24757 (RN-70060(Folder 2)) FOLDER 2: BUSINESS MANAGEMENT DEVELOPMENT OF AN IMPROVED NEUTRON ACTIVATION PREDICTION CODE SYSTEM. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 22 Apr 1970. 44p. Dep. NTIS $5.25.

The objective of the proposed program is to develop an integrated system of computer codes to compute photon dose rates generated in complicated engineering structures as a result of neutron-induced activation. Interest in developing this specialized computer-code package stems from two basic convictions: (1) that residual neutron activation will play a significant role in nuclear-rocket applications, principally in relation to rendezvous and docking in orbit-to-orbit nuclear shuttle missions performed with reuseable engines, and (2) that Aerojet's experience in developing the NERVA engine has revealed the need for a versatile analytical capability to treat neutron transport and activation and the resultant photon transport. Folder 2 contains the business aspects of the proposal: costs, policies, capabilities, etc. (auth)

24758 (RN-71001A) SUPPLEMENT TO CONTRACT YEAR 1971 PROGRAM PROPOSAL, RN-71001. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 56p. Dep. NTIS $6.00.

Development projects are outlined with estimated costs. (LTN)

24759 (RN-71007 Folder 1)) (FOLDER 1: TECHNICAL PROPOSAL. Design of Long-Life, Space-Maintainable Nuclear Stage Regulators and Shutoff Valves. To George C. Marshall Space Flight Center. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1971. 48p. Dep. NTIS $5.50.

The overall objective is to select the most promising concepts of nuclear stage regulators and shutoff valves that can be designed with characteristics which render them suitable for being space-maintainable and capable of operation under the conditions set forth in the RFQ. During Phase I, specific design criteria will be established as the basis for selecting valve and regulator concepts. The concepts selected will take into consideration the problems associated with the selection of materials and design configurations (including tolerances) to ensure that the designs are capable of meeting the performance requirements under specified environmental conditions. Problems associated with leakage, wear and operating life, contamination, storage life, temperature, pressure, radiation, and vibration environments, and remote in-space maintenance will be solved for each concept selected. The three most promising valve and regulator concepts selected will be subject to further investigation and preliminary design drawings of each concept will be developed and submitted. The preliminary design drawings will dimensionally delineate the basic valve and regulator concepts and characteristics and specify the materials selected. (auth)

24760 (RN-DR-0019) PRELIMINARY EDITION, REON/SACRAMENTO MANAGEMENT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1964. 97p. Dep. NTIS $8.00.

With the imminent relocation of the REON organization to the Sacramento Plant, there is a need for a definitive document describing the resulting organization, its function, its interfaces with other Sacramento functions, its product, its customer, and other general planning data for the information and guidance of all concerned. It is the purpose of this report to fulfill this need. General background material is provided followed by detailed descriptions of manpower requirements, organization, contract task and sub-task management, facility fiscal requirements and fiscal considerations, security, safety and etc. The early history (1946-1964) of nuclear rocket engine development, and the ground rules under which it was carried out, are summarized. (auth)

24761 (RN-DR-0053) IGNITION SPARK DETECTOR FOR THE NES STEAM GENERATOR. Trisler, T. W.; Maurer, R. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1965. 22p. Dep. NTIS $4.25.

In the NES Steam Generator spark ignitor circuit one of three conditions will exist: (1) proper sparking, (2) no spark due to lack of proper voltage at the electrodes, and (3) no spark due to a shorted or fouled plug. As a result, the display should be "go" for (1), and "no go" for (2) and (3). Two basic approaches to spark detection were considered—the first utilizing 60-cycle components of current, and the other utilizing higher frequency components. Basic data were gathered on the 60-cycle approach and analyzed. It was soon found that this approach was impractical since the differentiation between "go" and "no-go" conditions was much too subtle. The method utilizing high-frequency components of arc current was investigated and found to be very practical. Furthermore, this method has been used for some time as an oscilloscope presentation for internal combustion engine operation diagnosis. A practical circuit utilizing these high-frequency components for detection was designed, tested, and delivered as an operational unit. (auth)

24762 (RN-DR-0071) AGC/WANL XE INTERFACES. (Aerojet-General Corp., Sacramento, Calif. (USA)). Oct 1965. 24p. Dep. NTIS $4.25.

Where both companies have some responsibility for a project, the responsibilities of each are defined and the other agrees to the defined division of responsibilities. (LTN)

24763 (RN-DR-0079(Vol. 5)(Bk. 1)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Volume V-Book 1. Specifications, Reliability and Quality Control Plans. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 95p. Dep. NTIS $7.75.

The engine model specification for the Preliminary Flight Rating Tests (PFRT) engines, the engine acceptance specification for the two PFRT and two deliverable engines, the PFRT specification, and an environmental test specification are listed. After completion of the engine optimization study, parameter values will be determined by mutual agreement between AGC and SNPO. Also included are the reliability and quality control plans. An important consideration in their development was the realization that a pure numerical-statistical approach to engine reliability would demand an inordinately high cost. The plan presented assures the required reliability with minimum cost by stressing careful design and analysis and immediate corrective action of malfunctions which occur during the development program. (auth)

24764 (RN-DR-0085) BACKGROUND AND CAPABILITIES FOR REMOTE HANDLING SYSTEMS. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1966. 31p. Dep. NTIS $4.75.

Remote handling systems have been provided to support the nuclear rocket reactor subsystem and the experimental engine test programs at the Nuclear Rocket Development Station, Jackass Flats, Nevada. The Nuclear Rocket Engine Test Stand and the Engine Maintenance, Assembly, and Disassembly Building are in the process of being completely equipped with such equipment. The basic functions of remote assembly and disassembly, remote transporting of the engine and components, remote installation and removal of the engine from the test facilities, remote positioning, remote checkout and test, remote post-mortem disassembly and examination, and remote actuation of protective devices have been accomplished. Specific equipment is described and illustrated by photographs. (auth)

24765 (RN-DR-0094) ASSEMBLY PROCEDURE FOR THE EXPERIMENTAL ENGINE INSTRUMENTATION INSTALLATION AT AGC-SACRAMENTO. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1967. 22p. Dep. NTIS $4.25.

24766 (RN-DR-0103(Vol. 3)(Bk. 6)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Volume III. Program Plan. Book 6. Management Networks. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 139p. Dep. NTIS $10.00.

Books 4, 5, and 6 of Volume III contain the Program Plan Management (PERT) Networks which describe the activities, logic, and span times required to accomplish the various projects deemed necessary in the achievement of the NERVA Engine Development Program goals. The individual networks are interfaced to each

other as appropriate to form a total network of Aerojet activities. Similar networks for the development and supply of nuclear subsystem components are provided by WANL under separate cover. Through prior coordination and agreement, the WANL network for the NSS will interface with and complement the Aerojet networks to provide a total program network. The program and procedures of NASA PERT-II developed by NASA were used in computerizing the data shown on the networks. (auth)

24767 (RN-DR-0103(Vol.4)(Bk.1)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Specifications-Volume IV. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 86p. Dep. NTIS $7.50.

The engine specification for the preliminary flight rating tests engines and the environmental conditions specification are provided. After completion of the engine optimization study, parametric values will be determined by mutual agreement between AGC and SNPO. (auth)

24768 (RN-DR-0103(Vol.4)(Bk.2)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Specifications-Volume IV. Book 2. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 295p. Dep. NTIS $17.75.

Detailed design criteria and requirements are supplied for major NERVA reactor components (Valves, turbopump, actuators, Nozzle, thrust structures, pressure vessel, instrumentation, control systems, pneumatic systems, etc.). In some cases procedures for acceptance testing are outlined. (LTN)

24769 (RN-DR-0136) ESTIMATED PERFORMANCE OF SEVERAL NUCLEAR POWERED ORBITAL INTERCEPTORS. Military Space Applications for NERVA-type propulsion. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1968. 22p. Dep. NTIS $4.25.

A possible early military application of solid-core nuclear propulsion is to provide maneuverability to manned orbiting vehicles. Sufficient propulsive capability can be given orbiters of the current AF/MOL size to permit the vehicle to perform substantial altitude and plane changes. Maneuverability of this magnitude could provide the military with an early capability for extended earth surveillance, orbital interception and inspection, orbital strike, ferry and tug operations, in-space maintenance, and emergency rescue. The vehicle analyzed has been named an orbital interceptor for convenience. Its total utilization could include these and many other tasks. An estimate of the performance of several maneuverable orbital interceptors powered by nuclear stages has been made, assuming a minimum energy trajectory model. Three NERVA-type nuclear engines are used, based on the established designs of small, medium, and large solid-core reactors. Stage tankage is sized for a fixed engine duration. The velocity capabilities of interceptors weighing to 200,000 lb are determined for each of the three nuclear systems. These velocities are then developed into altitude- and plane-change capabilities. The maneuvers begin on a 100 nautical mile circular orbit and terminate at orbits to 100,000 n.m. (auth)

24770 (RN-DR-0150(Bk.4)) FACILITY MODIFICATION LOGIC PROCEDURE. Preliminary Draft. Project 223. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jan 1970. 7p. Dep. NTIS $4.00.

Sixteen management and control steps through which all modifications of the ETS-1 test stand must pass are described and accompanied by a sequential flow diagram. They involve modification studies, master and modification listing, change proposal, program directive, outside contractor discussions, preliminary design package, preliminary design review, final design package, final design review, NERVA work authorization, fabrication order, installation, checkout, activation, product assurance, drawing update, S.O.P. update (manuals, checklists), modification review and final processing. (LTN)

24771 (RN-DR-0177(Bk.2)) PROPELLANT-FEED SUBSYSTEM. Book 2: Valves. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 294p. Dep. NTIS $17.75.

The design criteria and functional performance requirements of nine different valves in the NERVA Propellant Feed System are documented to provide a single source for information. The basic data for valve specification is provided. (LTN)

24772 (RN-DR-0182) EXTERNAL-SHIELD SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 51p. Dep. NTIS $5.75.

The Design Requirements Sheets presented cover the external shield subsystem as described in the NERVA Engine Specification Tree, AGC Drawing 1137101, "E" Change. The sheets are organized into two principal categories: Design requirements criteria generated externally (e.g., environments) to the component; component functional performance requirements for steady state, startup, throttling, shutdown, and cooldown operations. Requirements are provided for both nominal and malfunction performance conditions. The basic data for component specification preparation are provided, along with design criteria and functional performance requirements, so that all this information will be available in a single source. (auth)

24773 (RN-DR-0183) GIMBAL-ASSEMBLY SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 87p. Dep. NTIS $7.50.

The design requirements of the NERVA Gimbal Assembly Subsystem and its actuators are developed. They include the specified functional performance requirements for steady state, startup, throttling, shutdown and cooldown operations for both nominal and malfunction performance. They must be reliable and repairable and transmit the specified loads. (LTN)

24774 (RN-DR-0189) NERVA MATERIALS PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 148p. Dep. NTIS $10.50.

Material problem areas were established by consultation with the Project and Design Groups for the resolution of potential critical design problems. Irradiation testing is needed to assess ductility and toughness damage of the most marginal stress and temperature conditions that will be significant to design. The worst irradiation effect is generally at the lowest operating temperature, and consists of the effect of fast neutron irradiation which is to increase the tensile strength properties and to decrease ductility. The objective of tensile tests is to determine if the elongation of a "ductile" material will be reduced below the limit which is acceptable to use "ductile" design criteria. Many of the NERVA materials in normal service will be exposed to both irradiation fluence and hydrogen simultaneously that raises concern over synergistic deterioration effects. Since the diffusion rate of hydrogen is nil at or below 140°R, concern for bulk hydrogen penetration at cryogenic temperatures should not be significant. There is a remote possibility that surface concentration of atomic hydrogen could be enhanced by the irradiation fluence and result in increased crack propagation rates. Therefore, the dual effect of irradiation and hydrogen embrittlement will be evaluated by screening effects materials tests. The gaseous helium facility at PBRF is deemed adequate for the major part of the irradiation test program. Various aspects of the materials testing program are discussed in detail. (auth)

24775 (RN-DR-0190(Vol. 2)) PROGRAM PLAN FOR DEVELOPMENT OF THE INSTRUMENTATION AND CONTROL (I AND C) SYSTEM FOR THE NERVA ENGINE. Volume II. Appendices. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Jan 1970. 159p. Dep. NTIS $11.00.

Programs dealing with engine controls, malfunction detection and corrective action, engine and nuclear measurements, measurement signal processing, electrical power, reactivity mapping and controls design analysis are outlined. (LTN)

24776 (RN-DR-701) SPEAR TERM REPORT, XECF EP-1. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 2 Apr 1968. 174p. Dep. NTIS $11.75.

The XECF EP-1 test conducted on April 2, 1968 was the first test of an engine system at ETS-1 and was intended to demonstrate that all facility systems and procedures were satisfactory for engine testing. The XECF Engine contains an inert core and four tests were planned for EP-1 to obtain additional X Engine bootstrap information. The test was very successful in its main objective, to operate all of the ETS-1 systems in conjunction with an engine. All systems including the LH_2 System, the GH_2 System the GN_2 System, the GHe System, the Steam Generators, the Duct, the Engine Test Compartment, and the Data Systems were operated in their intended manner. With all these systems functioning, the cold flow engine was started and data were obtained. The test operating team demonstrated a capability to operate the facility and react swiftly in a safe manner when unexpected events occurred. A number of anomalies were encountered and not all of the planned tests were carried out due to adverse weather, low helium supply, etc. (auth)

24777 (RN-FR-0072) PROPOSED MONTHLY FISCAL REPORT COVERING PERIOD OF DECEMBER 1969. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). [nd]. 112p. Dep. NTIS $8.75.

Cumulative graphs of planned and actual costs for the fiscal year to date are provided for each active project and totalled for the company and 4 different agencies. (LTN)

24778 (RN-NC-0017) PERFORMANCE OF THREE SIZES OF SOLID CORE NUCLEAR ENGINES FOR SPACE MISSIONS.

(Aerojet-General Corp., Sacramento, Calif. (USA)). May 1968. 34p. Dep. NTIS $4.75.

The NERVA-type solid-core nuclear engines are compared on the basis of primary propulsion for a representative group of space missions. The mission opportunities occur in the 1975-86 time period and represent applications desirable for solid-core systems on the basis of the NASA space exploration goals, engine performance and development schedules, and growth in nuclear-stage operational experience. Comparison begins with unmanned planetary flybys in the 1975-79 time period, through unmanned orbiters in the 1978-83 time period, and then manned orbiters to Mars, Venus and Mercury in 1982 through 1985. The final mission considered is a landing on Mars in 1986. The study shows that large Voyager-size (20,000 lb and up) payloads can be placed in orbits around Mercury, Venus, and Mars. Payloads of similar size can be achieved for flybys of Jupiter and to the planets beyond Jupiter if the Jupiter swing-by is used. The effect of a reduction in thrust of 20% has a negligible effect on missions to Mars and the interior planets. The effect becomes appreciable to planetary bodies beyond the asteroids. Increasing the thrust 67% and the I_{sp} to 1000 sec results in a marked increase in performance for all missions considered. The intent of the information presented is to provide basic mission capability data for use in summary documents and presentations. (auth)

24779 (RN-NC-0019) FEASIBILITY STUDY OF FLUIDIC SUBSYSTEM FOR NERVA-ENGINE CHAMBER-TEMPERATURE CONTROL. IR and D Progress Report, FY 1968. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1969. 95p. Dep. NTIS $7.75.

Significant details of fiscal-year 1968 research and development on the NERVA-engine fluidic chamber-temperature-control subsystem are described. No flueric gas-temperature sensor now under development was suitable because of the preliminary state of the technology and the physical limitations of the devices. Experimental work on the low-frequency relaxation oscillator and on confined-volume gas-temperature sensors shows promise of possible use in the chamber-temperature-control subsystem. The relaxation oscillator could be used as a primary sensor, and the confined-volume device could be used as a rate-of-temperature change sensor. Initial flueric-component-matching design work was performed with a confined-volume temperature sensor used to activate a flueric temperature-rate limit switch in both the positive and negative direction. The low-frequency relaxation oscillator was redesigned to make it insensitive to pressure. The frequency limits are well within the range of direct flueric demodulation circuitry necessary for system synthesis. Metallic forming of flueric parts by explosive compaction was explored. (auth)

24780 (RN-NC-0021) IR AND D FINAL REPORT, FY 1969. Feasibility Study of a Fluidic System for NERVA-Engine Chamber-Temperature Control. Butler, K. C.; Thomas, R. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1970. 86p. Dep. NTIS $7.50.

The overall objective was to evaluate the basic feasibility of utilizing fluidic components and concepts to monitor and control the NERVA reactor gas temperature. Efforts consisted essentially of three major tasks: Evaluation of a fluidic temperature sensor, evaluation of an all-fluidic, sensor-output demodulating circuit, and investigation of a fluidic circuit to provide for control of the reactor moderator hydrogen flow. Analysis and screening of fluidic temperature sensor concepts indicates that the relaxation oscillator concept is the most practical of those considered. This device can be designed to indicate chamber gas temperature within 25°R in a range of 500 to 5000°R. Extensive testing of the relaxation oscillator with nitrogen and helium indicates that, under proper operating conditions, the frequency varies directly as the square root of the gas temperature-gas constant product and is insensitive to pressure. Variable gas temperature tests with helium were conducted up to 2000°R with a stainless steel relaxation oscillator configuration, but under certain conditions this device appeared to be slightly pressure sensitive. The relaxation oscillator was successfully coupled to an all fluidic demodulating circuit. This is a pulse-frequency modulation network that generates a dc output pressure proportional to the frequency of the oscillator, hence to the square root of the sensed gas temperature level. The oscillator and demodulating circuit operated satisfactorily together over an oscillator flow gas temperature range of approximately 500 to 1000°R with helium. The circuit was demonstrated to be completely insensitive to the oscillator pressure level. Two additional demodulating circuit schemes were examined. These alternative circuits appear to be functionally sound and it is recommended that further consideration be given to them. A preliminary feasibility investigation of a fluidic support structure coolant valve (SSCV) system was conducted. This study indicates that an all fluidic SSCV system is a reasonable possibility. (auth)

24781 (RN-PA-0011) NERVA CONFIGURATION MANAGEMENT AND MPT/NERVA ENGINE INTERFACE. A Presentation to SNPO-C, MSFC, and SNPO-W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Jul 1967. 124p. Dep. NTIS $9.25.

The main objectives, interfaces, design disclosure documents, and attendant release schedules of the NERVA configuration management plan are discussed, and the interrelations among the specifications for the engine, ground support equipment, test-stand, and the module-propellant-tank are examined. (DG)

24782 (RN-PA-0016) STATUS OF NERVA SHIELDING REQUIREMENTS TRADE STUDY (TASKS 2 AND 2A). (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Feb 1969. 69p. Dep. NTIS $6.50.

The major conclusions presented at a shielding review meeting were: The use of uncooled disk shields results in essentially the same system weight as use of variable internal and brim shields within practical weight ranges; a split between shielding located at the engine and at the payload results in minimum system weight and the amount of added weight at both locations is strongly dependent on indigenous payload attenuation; and it would appear that total system weight additions to the engine will not exceed approximately 10,000 lbs (including basic internal shielding required for unmanned missions). Qualification testing of the engine shielding will have to be accomplished in a low background facility; e.g., with the engine supported from above. (auth)

24783 (RN-PA-0018) SYSTEMS-ENGINEERING AND TRADE-STUDY-REPORTS MEETING (BOOK 1 OF 2). (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 22 Apr 1969. 277p. Dep. NTIS $17.00.

Material presented at the meeting is mostly in the form of slides, which are documented. (LTN)

24784 (RN-PA-0025) PRESENTATION MATERIAL FROM JOINT AGC-WANL SYMPOSIUM ON NERVA INSTRUMENTATION AND CONTROL. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1969. 246p. Dep. NTIS $15.50.

The NERVA Technology Engine Control and Instrumentation System and the significant test results are described. Engine startups were accomplished over a wide range of conditions (approximately NERVA range). The Temperature Autostart was demonstrated (no nuclear instrumentation). Critical measurement without nuclear instrumentation was also demonstrated as well as startup for backup purposes. Engine Control performance over the various parts of the operating map was discussed. The significant impact of the accuracy of the engine model on the control design was demonstrated by these results. The controls were able to support all the test objectives. The basic objectives of the XE-P shutdown controls were to safely shut the engine down to the point where engine cooling could be sustained with run tank pressure and to gain shutdown experience applicable to NERVA; both objectives were met. All engine shutdowns during the test series (approximately 19) remained within operational constraints. The variability of engine shutdown characteristics with operating history indicates that the main development area for NERVA shutdown controls will be that of obtaining predictable shutdowns in terms of time and total impulse while maximizing I_{sp}. The XE Instrumentation showed good performance; about 90% of all transducers survived. Pressure measurement drift was corrected after it was discovered. Experimental dosimeters were used with varying degrees of success. Vibration measurements below the engine shield were a problem, which is still unsolved although much good data were obtained. Control drum torque transducers experienced problems at time of installation and aside from some early failures provided good data. The Technology program provides a good basis for the NERVA development task; However, no transducer is "qualified" as such. Some designs present extremely difficult problems, the most severe of which are high temperature measurements as effected by thermal cycling. A real problem exists for dosimetry; one which has had postulated solutions but nothing demonstrated as satisfactory. Pressure transducers below (aft of) the internal shield are difficult problems because of high gamma rates and neutron damage. Strain gages present a difficult task because previous test results indicate that the present design cannot predictably perform in this neutron environment. Present gages are too large for many NERVA applications. Most other measurements can probably be given significant confidences as a result of further testing and development based on the foundation of Technology experiences. (auth)

24785 (RN-PA-0026) MATERIAL PRESENTED BY AEROJET TO SNPO-C ON COMPLETION OF TASKS III AND IV OF SHIELD-

ING TRADE STUDY. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 May 1969. 116p. Dep. NTIS $9.00.

Slides and brief text of a presentation on a shielding trade study are documented. (LTN)

24786 (RN-PA-0027) PRESENTATION MATERIAL FOR LONG-RANGE PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 74p. Dep. NTIS $6.75.

Slides and a brief text of long range plans for the NERVA program (to 1978) prepared for presentation in December 1969 have been documented for review purposes. (LTN)

24787 (RN-Q-0041) QUARTERLY PROGRESS REPORT NO. 41 FOR SECOND QUARTER, CY 1967 COVERING THE PERIOD OF JANUARY, FEBRUARY, AND MARCH 1967. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Products and Services Group). Apr 1967. 266p. Dep. NTIS $16.50.

Fabrication of XECF and XE-1 components was completed, and engine-systems assembly progressed. The mechanical and electrical assembly operations were accompanied by functional checkouts; i.e., electrical checkouts, leak checks, and mating of the modules. Design modifications of the type normally expected during the first assembly of an engine system were made during the assembly period. The XECF lower module assembly was completed and shipped. Assembly of the remaining engine systems will continue into the next quarter. Cryogenic testing of the XECF upper-thrust-structure module (UTSM) and shield assembly along with the TSA assembly was performed to verify the design adequacy of the insulation and GN_2 purge-system provisions in the engine design. The results indicate that these provisions will adequately reduce any adverse effects of engine operation caused by formation of LN_2 in the UTS compartment during testing at NTO. Various other production, design and testing results are given. Several ETS-1 testing facility modifications are discussed. (auth)

24788 (RN-Q-0044) QUARTERLY PROGRESS REPORT NO. 44. For First Quarter, CY 1968, Covering the Period of October, November, and December 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1968. 272p. Dep. NTIS $16.75.

Test-Cell-C facility construction and modification activities were completed in preparation for the Phoebus-2A shutdown and the NRX-A6 test series. The NRX-A6 full-power test was successfully performed on 15 December 1967. The filter, reactor outlet gas (FROG) system was installed and used for the first time in the NRX-A6 test. The system was highly successful, resulting in only slight radioactive contamination in the test-cell area, whereas the cell had been grossly contaminated after previous reactor tests. Postoperative examination of the NRX-A6 was initiated in R-MAD. The NRX-A6 test data are being analyzed in detail. The XECF was transported to ETS-1 on 5 October 1967. Anomalies at the TSA-UTS interface were discovered when the XECF was remotely installed at ETS-1 on 10 October 1967. After corrective action, the XECF was installed, remotely removed, and then remotely reinstalled on 22 November 1967. The XE-1 PVARA was cleaned of all debris, and reassembly was completed. A temporary hold on the XE-1 is in effect pending results of WANL investigations of two defective control-drum actuators. A malfunction analysis of the XE-1 engine system was conducted to evaluate the adequacy of the engine safety system starting from steady-state and transient conditions. The preliminary or conceptual design activity for the 200,000-lb-thrust NERVA engine was eliminated during this report period. Preparation of definition and preliminary design criteria was initiated on a 75,000-lb-thrust engine. (auth)

24789 (RN-Q-0049) QUARTERLY PROGRESS REPORT NO. 49. For Second Quarter, CY 1969, Covering the Period of January, February, and March 1969. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 319p. Dep. NTIS $19.00.

Work continued in three broad areas: the technology program, the NERVA flight-engine program, and various support activities. The highlight of the period in the technology area was the successful performance of low-power mapping tests with the XE-Prime engine in ETS-1. The XE-Prime testing program continued with the accomplishment of EP-IB, EP-II, and EP-IIA. The engine was checked out through drum and power calibration tests and successfully demonstrated three bootstraps, reaching a peak reactor power of 204 Mw. The steam line modification was completed and the line was successfully tested. Numerous other facility and control modifications were performed. Studies relating to future seismic events and means of facility and engine protection have been made. Many other planning, design and testing results are discussed in detail. (auth)

24790 (RN-Q-0051) QUARTERLY PROGRESS REPORT NO. 51. For First Quarter, CY 1970, Covering the Period of October, November, and December 1969. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1970. 311p. Dep. NTIS $18.75.

Work was continued in two broad areas: the NERVA flight-engine program and various support activities. The NERVA engine design has been redirected to the full-flow cycle; effort on the hot-bleed cycle has been concluded. The new program plan, which calls for a qualified full-flow engine in 1977, has been transmitted to SNPO-C. Emphasis on reliability and maintainability has been increased because of the increased engine life requirements. Revised engine layout and piping drawings were prepared to support efforts on the full-flow engine cycle. Trade studies were defined and initiated, and some were completed. The reference-engine design includes the dual-TPA concept and has a disk-type external shield. Identification of valve concepts was initiated by using the results of hot-bleed concept studies where applicable. The design of electric actuators was initiated. An internal thrust structure was designed that allows greatly increased component accessibility. Fault-tree analysis was applied in evaluating the reference full-flow engine. Various support and testing activities are discussed. (auth)

24791 (RN-S-0059) SCALE MODEL HEAT TRANSFER TESTS OF THE NERVA NOZZLE, CY 1963. (Aerojet-General Corp., Azusa, Calif. (USA)). Mar 1964. 240p. Dep. NTIS $15.00.

Heat transfer experiments and theoretical analyses were conducted to obtain data applicable to various sections of the NERVA nozzle as follows: An experimental and theoretical hot-gas-side heat-transfer program to better define the film temperature effect on heat transfer; a liquid-side heat-transfer program to determine the effects of system geometry on the heat-transfer characteristics of cryogenic hydrogen and to correlate the experimental data; scale model tests to determine the effect of streaming from a metal bottom support plate (MBSP) on the hot-gas-side heat-transfer coefficient in the convergent section of the nozzle and the bleed port; graphite corrosion tests in H_2/O_2 gases to establish the feasibility of hot simulation testing a MBSP which would use graphite as a protector; and simulation tests of a tie rod support button for the B-4 core. (auth)

24792 (RN-S-0078) STEAM GENERATOR SYSTEM TEST PROGRAM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1964. 69p. Dep. NTIS $6.50.

A three phase test program is proposed to develop and demonstrate the reliability of the ETS-1 steam generator system and the facility steam pipe. The test program has been arranged to most beneficially utilize available time following fabrication of the steam generator system and activation of the steam generator facilities at ETS-1. The "Safety and Malfunction" test program will be conducted by Thiokol at their RMD test facility on the spare generator module to explore safety and malfunction modes. A considerable time advantage is gained in conducting these tests in advance of the program at ETS-1. Major problem areas can be discovered early and, if required, field changes can be implemented without seriously disrupting the remainder of the test program or affecting scheduled engine tests at ETS-1. The testing at Thiokol enables a reduction in testing during the system development tests. Only tests necessary to check sequence circuitry and demonstrate system performance are included. The "Design Demonstration Test Program" will be conducted following installation of the permanent I&C. A two part program will be required since installation of the facility steam pipe and NES duct will not be completed at this time. Therefore, during the first part of the program steam will be discharged through the test pipe. This part of the program will provide extensive testing to demonstrate safe performance of the steam generator when operated with the permanent I&C. Following installation of the facility steam pipe and the NES duct, the second portion of the Design Demonstration Test will be conducted concurrently while supplying steam for NES duct testing. Testing at this time will include simultaneous operation of three generators to demonstrate overpressure protection. (auth)

24793 (RN-S-0130) ETS-1 FACILITY ACTIVATION PLAN FOR CY '64, '65, AND '66. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Sep 1964. 192p. Dep. NTIS $12.75.

The 88 tasks which must be completed to make the Engine Test Stand (ETS-1) ready by April, 1966 are listed, defined and scheduled. Manpower requirements are specified. (LTN)

24794 (RN-S-0195) NUCLEAR EXHAUST SYSTEM DUCT. Presentation to Air Preheater Co., Wellsville, N. Y. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1965. 25p. Dep. NTIS $4.25.

The significant items and requirements involved in design and procurement of the Nuclear Exhaust Duct for the Nerva Program are presented. The duct is to be installed in Engine Test Stand No. 1 at the Nuclear Rocket Development Station at Jackass Flats, Nevada. The purpose of the duct is to conduct the hot, combustible gases away from the test stand during an engine test firing. (auth)

24795 (RN-S-0231A(Rev.)) XE-1 ENGINE ESTIMATED WEIGHT AND BALANCE REPORT. Revised. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 33p. Dep. NTIS $4.75.

A revised summary of the XE-1 engine weight and center of gravity is presented. The part numbers, weights and centers of gravity of components are listed. The engine considered uses an aluminum pressure vessel and a steel-jacketed hot-bleed port nozzle. (LTN)

24796 (RN-S-0298 (Final)) CFDTS SERIES I, II, AND III TESTS. Final Report. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1966. 204p. Dep. NTIS $13.25.

The primary purpose of the Cold Flow Development Test System (CFDTS) program was to verify that engine "bootstrapping" could be initiated by nozzle-chamber bleed to the turbine and to provide data related to the behavior of the NERVA hot bleed engine during startup. Program objectives were achieved. The system successfully "bootstrapped" and useful information was obtained for upgrading and improving the computer models simulating the system as well as for improving the engine system itself. The engine system (which was the first test assembly containing all major engine components to form the full-size NERVA rocket engine with an unfueled reactor assembly), the test facility and the instrumentation are described. A summary of the test results is presented. A detailed report of the results (RN-S-0294, title CFDTS Data Analysis Final Report) is available for additional information. (auth)

24797 (RN-S-0348) OPERATING AND MAINTENANCE INSTRUCTIONS XE-1 TURBINE POWER CONTROL VALVE (TPCV) ACTUATION SUBSYSTEM. Funnell, W. F.; Krauter, K. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1967. 54p. Dep. NTIS $5.75.

This manual describes the turbine power control valve (TPCV) actuation subsystem, which is part of the NERVA engine pressure control system. The purpose is to assist the operating personnel in understanding the installation, integration, operation, and maintenance of the TPCV actuation subsystem. (auth)

24798 (RN-S-0350) OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 TEST STAND CONTROL SYSTEM; (TSCS), TEST SIMULATION SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 423p. Dep. NTIS $24.25.

This manual is intended to be a useful tool to help understand the operation, maintenance and the theory concerning the computer simulation of the engine and cooldown systems for ETS-1. The Test Simulation System (TSS) for ETS-1 is shown and is housed in Racks 58, 59, 60, 61 and 62, within the Test Cell Building. This test simulation system is used for training of operating personnel and checkout of the facility and engine control systems. The simulator is an electronic simulation of the mathematical equations which define the engine and cooldown system. The hardware is arranged so that the engine simulation and the cooldown simulation can function independently. The simulator consists of network cans plus standard analog computing modules. These cans and modules can easily be inserted or removed from their blue-ribbon connectors by sliding in and out from the front of the rack. Most maintenance and repair can be done by replacing commercial plug-in units or replacing components within the network cans on a work bench away from the close quarters of the simulator itself. (auth)

24799 (RN-S-0352(Rev.B)) XE-1 TEST SPECIFICATION. Revision B. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1968. 128p. Dep. NTIS $9.50.

24800 (RN-S-0354(Rev.A)) XECF TEST PREDICTIONS. Revision A. Hampson, L. K.; Sebek, E. J.; Stiger, R. R.; Williams, R. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1967. 119p. Dep. NTIS $9.00.

Predictions are presented and discussed for all tests outlined in RN-S-0314, XECF Test Specification, and in modifications No. 1 and 2 thereof. The test-prediction analysis indicated that, under all test conditions considered, the test-parameter limits would at no time be exceeded; and no unsafe conditions were disclosed that could result in damage to the test article or facility. Descriptions of the engine system, the test facility, and the instrumentation system are included so the report can be used as a comprehensive reference document during quick-look analyses of test results. (auth)

24801 (RN-S-0378) ETS-1 FACILITY SAFETY REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1968. 28p. Dep. NTIS $4.50.

The system changes or additions discussed have materialized primarily as a result of intensive studies related to backflow of air into the NES duct and ETC and the possible accumulation of hydrogen and propane in confined and restricted spaces or other undesirable locations. These modifications have been incorporated for protection against the indicated hazards and have been thoroughly reviewed and evaluated from a safety standpoint. (auth)

24802 (RN-S-0378) ETS-1 FACILITY SAFETY REPORT. Duncan, D. S.; Booth, H. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1967. 268p. Dep. NTIS $16.50.

The purpose is to show that the ETS-1 facility is adequate from the design standpoint to support the X-engine test program without compromise to the safety of personnel, the facility, or the test article. Each of the facility systems which will be utilized during X-engine testing and which may be expected to have a difinite influence on test safety is evaluated. For each system requirements and characteristics, operation and control capabilities, safety features, and consequences of system or component malfunctions, as appropriate, are discussed. The evaluation of each system is concluded with summary which indicates why the system is considered adequate from the safety standpoint to support the X-engine test program. (auth)

24803 (RN-S-0400(Phase 2)) XE TEST SPECIFICATION. Phase II. Operational Sections. II.D.2. Specific Test Requirements. III.E. Data Processing and Distribution. III.F. Transfer Response Measurements. III.L. Test Limits Justification. Final Issue. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Nov 1968. 84p. Dep. NTIS $7.25.

This phase of the XE test series at ETS-1 covers the attainment of initial criticality, scram and control-systems checkout, power calibration of the TSCS shield-mounted neutronic detectors, activation of dosimetry, and control-drum calibration. The major objectives of these tests will be: To determine the worth of the S-1 side shield, to attain initial reactor criticality and determination of the critical control-drum bank position with all poison wires removed, to achieve power calibration of the TSCS shield-mounted neutronic detectors and engine-mounted neutron detectors (EMND), to ensure that the individual control-drum worths are adequate for power testing and verify that the worth of each drum is approximately equal to that of each of the other drums, to perform nuclear auto start and power control checkout tests, and to activate the low- and intermediate-level dosimetry. (auth)

24804 (RN-S-0400(Enc. 2)(Phase 2)) XE TEST SPECIFICATION. Phase II. Operational Section. II.D.1. General Test Requirements. Final Issue. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Nov 1968. 28p. Dep. NTIS $4.50.

The operational specifications are set forth for the engineering requirements of the XE test series, including those for test monitoring, test parameter limits, the control system, the conduct of the tests, emergency shutdown, and other pertinent information, that provide a basis for preparation of the procedures for the X-Engine tests. The operational phase of the program to be conducted is divided into the following phases: Initial Criticality and Control Drum Calibration, Low Power Flow Tests, and Intermediate and Rated Power Tests and Temperature Auto Start Tests. The Phase I tests comprise the pre-power checkout and calibration tests, and include low and intermediate level dosimetry irradiation. Phase II is a series of low power flow tests, duplicating portions of the engine startup procedure. Phase III tests include the intermediate and rated power tests, and temperature autostart tests. Starts with high total I_{sp}, high thrust starts, and engine restarts will also be demonstrated in the Phase III tests. (auth)

24805 (RN-S-0400(Rev.A)) XE TEST SPECIFICATION. Revision A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Dec 1968. 31p. Dep. NTIS $4.75.

24806 (RN-S-0418(Bk.1)(Sect.8)) XE-P TEST PREDICTIONS. Section 8 (Phase II Low-Power Flow Tests) Revision. Book I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Mar 1969. 17p. Dep. NTIS $4.00.

Revised low-power flow test predictions are presented in the form of strip chart recordings of engine operating parameters as functions of time. (DG)

24807 (RN-S-0418(Bk.1)(Sect.9)(Phase3)) XE-P TEST PREDICTIONS: SECTION 9 PHASE III INTERMEDIATE AND RATED POWER TESTS, AND TEMPERATURE AUTOSTART TESTS. Book 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1969. 22p. Dep. NTIS $4.25.

In addition to evaluating startup and shutdown techniques, these planned tests will demonstrate the startup capability of the engine

system to an intermediate power level, the capability of the control systems to achieve demanded conditions up to and including rated power, and the capability of the facility to support engine tests at rated power. Startup limitations, temperature autostarts, pulse cooling, high I_{sp} and high-thrust startup and shutdown, engine restart, and repeatability of performance will also be demonstrated. Transfer-function measurement will also be taken at specified conditions. The engine operating characteristics predicted for the XE-P test program were obtained from the XE common analog model (CAM). (auth)

24808 (RN-S-0418(Suppl. 1)) XE-PRIME TEST PREDICTIONS. Supplement No. 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 59p. Dep. NTIS $6.00.

The XE-Prime engine will be the first nuclear powered engine system to be tested in the ETS-1 facility which permits a much closer approach to testing of a flight-type nuclear-powered system than previously possible because: the engine is located immediately below, and close-coupled to, the liquid-hydrogen supply tank; and the engine will be fired downward in a simulated high-altitude environment. Predictions of the operating characteristics of the XE-Prime engine are made. They were prepared for use in test planning, test monitoring, and immediate posttest analysis. The basic information is presented in plots of predicted engine parameters which will be measured versus time. These are accompanied by a written discussion of the predicted performance during each test. There are also sections which provide information on engine measurements and major test facilities and measurements. The objective of the XE-Prime test series can be divided into two main categories: determination of engine operating-characteristics and establishment of a technical basis for development of engine control for future engine systems; and evaluation of engine and test stand components in a nuclear environment and the development of engine operational procedures for flight. (auth)

24809 (RN-S-0418(Suppl.3)(Phase3)(Rev.)) XE-P TEST PREDICTIONS: REVISION TO SUPPLEMENT 3 TO SECTION 9 PHASE III RUN 5. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 May 1969. 9p. Dep. NTIS $4.00.

24810 (RN-S-0465) NERVA MANAGEMENT PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1968. 181p. Dep. NTIS $7.25.

The NERVA Management Plan has been prepared by Aerojet for the purpose of effectively managing the NERVA Propulsion System contract, SNP-1, and is consistent with the management principles and objectives delineated in the AFSCM 375 series of documents. It is intended to serve as a management tool by defining the management procedures required to integrate all significant management actions necessary to provide a suitable system in an effective and efficient manner. Aerojet will adhere to this plan for the life cycle of the NERVA Propulsion System. Discrete PERT networks will depict (at the appropriate level) the actual flow of hardware design, development, fabrication, testing and assembly for all of the test article Contract End Items and components of the NERVA Propulsion System. Appendix B is a complete listing of data items to be produced and submitted to SNPO. It shows the frequency of submission, and the reference authority for their preparation. (auth)

24811 (RN-S-0473) EVALUATION OF XECF THRUST STRUCTURES. Tracy, D. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1968. 14p. Dep. NTIS $4.00.

Performance of the thrust structures, consisting of an upper thrust structure (UTS) and a lower thrust structure (LTS), was evaluated during the XECF program using strain and temperature data obtained during the test. The loads on the UTS and LTS during the XECF test were insignificant compared with the loads imposed on the structure during the acceptance-proof-test program. (auth)

24812 (RN-S-0506) NERVA MISSION DATA BOOK. Lavenda, T. E.; Rishel, R. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1969. 231p. Dep. NTIS $14.75.

The space missions described are being studied primarily for the purpose of evaluating and generating engine requirements which will lead to an engine with a high degree of mission flexibility and the missions and their operating modes were selected accordingly. Although the missions come from Appendix B of the NERVA Program Requirements Document they are not necessarily to be construed as the missions in which NASA will ultimately use the NERVA engine. (auth)

24813 (RN-S-0556) ETS-1 SEISMIC MODIFICATIONS, SUMMARY REPORT. Leerskov, N. C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 34p. Dep. NTIS $4.75.

As a response to manmade seismic events occurring at the test site vicinity and the expectation of other such events, the ETS-1 test facilities were reinforced. The initial design of reinforcements had to be redesigned as a result of a stronger seismic event which occurred before construction started. Different methods of analysis of the time-history acceleration data of the event created problems in selecting the redesign which were finally resolved. The redesign was based on tests of the modal and dynamic response analysis of a mathematical model of ETS-1 subjected to the time-history acceleration of the stronger event. All essential construction was completed March 12, 1970 and satisfactorily withstood another seismic event. (LTN)

24814 (RN-TD-0053) DEMONSTRATION TEST REPORT FOR THE XE TURBINE POWER CONTROL VALVE FOUR-INCH BUTTERFLY VALVE OPERATED BY A HYDRAULIC ACTUATOR. Mathews, J. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). 12 Mar 1969. 45p. Dep. NTIS $5.25.

Following valve bearing design modifications XE Configuration Turbine Power Control Valve (Butterfly Type Valve) demonstration tests were conducted. A Servo-Controlled Hydraulic Actuator was substituted for the Bendix Electropneumatic Actuator since the latter was not available for demonstration test use. As a result of these tests it was concluded that the valve would operate successfully in the X-Engine flow, temperature, and pressure environments. (auth)

24815 (RN-TD-0058) PUMP DISCHARGE SHUTOFF VALVE RANDOM VIBRATION TESTING. Final Report. Lundback, A. V. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1969. 42p. Dep. NTIS $5.25.

Random vibration tests of a five-inch, normally open, butterfly-type pump discharge shutoff valve (PDSV, P/N 1114342-9, S/N 880005) were carried out. The PDSV withstood the vibration environment imposed by all phases of the test program and no detrimental structural failures were noted which were directly attributal to vibration. Although cracks were observed in the liquid nitrogen drip shield, it was still securely attached to the actuator body and would continue to perform its intended function if the valve were installed on the engine. The functional tests which were conducted following the vibration tests (to verify smooth cycling and consistent cycle times) were satisfactorily performed and no anomalies with respect to the cycle times and position traces were observed. It is concluded that a potentiometer assembly design change is not necessary to assure a satisfactory position trace recording during engine operation. The increased butterfly-gate lipseal leakage rate was approximately equivalent to a 1×10^{-3} lb/sec liquid hydrogen leakage which is not considered detrimental to engine operation. The equivalent 70-minute run time objectives were acheived in the longitudinal direction and exceeded in the radial and tangential directions. Variance of the test-response peak frequencies and magnitudes with the engine-predicted responses is attributed to the difference in test setup configurations; therefore, it has been determined that the test objectives were achieved within the practical limits of the test program and the PDSV is considered acceptable for use during 70 minutes of XE-engine operation. (auth)

24816 (RN-TM-0018) NARRATIVE END ITEM REPORT: $\frac{3}{8}$" CRYOGENIC CHECK VALVE, P/N 1114730-29, S/N's 880001, 880002, 880003, AND 880004. Toboni, J. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 9p. Dep. NTIS $4.00.

The procedures and methods used in the acceptance testing of $\frac{3}{8}$ in. Cryogenic Check Valves (AGC Drawing No. 1114730) are described. The requirements of each phase of testing were met satisfactorily and each unit was therefore considered acceptable for use in the X-engine system. (LTN)

24817 (RN-TM-0133) NERVA TEST PLAN TURBINE POWER CONTROL VALVE (TPCV) P/N 278100, CRYOGENICS LABORATORY TESTS. Dorian, J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Dec 1964. 22p. Dep. NTIS $4.25.

Test specifications are developed for cycling the turbine power control valve in hydrogen at 1200°R. Besides the main requirement of operation for 100 minutes, and including 300 full operating cycles, without a malfunction, seal configuration and bearings are to be evaluated. (LTN)

24818 (RN-TM-0139) CALCULATION OF EQUATION FOR SPECIFIC HEAT AND SPECIFIC HEAT RATIO AS A FUNCTION OF TEMPERATURE RANGE LIMIT 600°R TO 1800°R. Chew, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 8 Dec 1964. 27p. Dep. NTIS $4.50.

Polynomial fits of the specific heat, and the ratio of specific heats, as functions of temperature are given as polynomial fits

to the data for hydrogen between 600°R and 1800°R. These functions are needed for NERVA turbopump calculations. (LTN)

24819 (RN-TM-0141) DESIGN REPORT: TURBINE POWER CONTROL VALVE FOR USE AS DILUENT CONTROL VALVE IN CRYOGENIC SERVICE. Dorian, J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 12 Apr 1965. 25p. Dep. NTIS $4.25.

A design analysis of the Turbine Power Control Valve was conducted to investigate its suitability for use as a Diluent Control Valve. Factors of safety used in the analysis were 1.25 for yield strength and 1.50 for ultimate strength. All margins of safety calculated for the components were positive. The results of this design analysis indicate the valve is suitable for use in cryogenic service. (auth)

24820 (RN-TM-0145) BASIC LOADS AND STRUCTURAL DESIGN CRITERIA FOR THE NRX/EST ENGINE. Lucier, J. R.; Talbott, K. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Jan 1965. 11p. Dep. NTIS $4.00.

Loads are divided into primary and secondary loads for the purpose of defining their importance. Primary loads are those caused by inertia, pressure and thrust, while secondary loads are those which might occur from an unusual source, such as a sudden jolt on the test car or a break in the propellant line at the nozzle, which would produce a side thrust on the engine. Secondary loads may combine with primary loads to produce a maximum expected loading condition on the engine. In addition, the effects of vibration and temperature are considered as secondary loads. A component weight breakdown versus station has been calculated for the engine system. The center of gravity, mass moment of inertia, horizontal and transverse shear, and bending moment per inch of engine length have been calculated and tabulated. The engine maximum expected thrust is considered to act on all engine interface connections from the nozzle-pressure vessel interface to the thrust ring-test stand interface. Engine thrust values used are given in the NRX-EST Preliminary Engine Specification. The maximum expected pressure schedule for the NRX-EST pressure vessel is also contained in the Preliminary Specification. These pressures will be combined with the appropriate design factor for analysis of any components of the pressure vessel modified for this engine configuration. Calculations of the effect of car jolting or the possible line failure mentioned above have led to the formulation of a 1 g side inertia loading, based on the distributed weight of the engine in its cantilevered position (nozzle up) on the test car. Loads caused by temperature changes in the pressure vessel or lines occur when normal temperature expansion or contraction is prevented. In most cases, differential growth potential has been designed into the system. In some cases, however, it may not be possible to avoid restraint and thermal loads will occur. Loads caused by temperature change can often create stresses which apparently exceed the yield stress of the material by a considerable margin based on elastic theory. The true stress, however, follows the stress-strain curve for the material beyond the yield point. (auth)

24821 (RN-TM-0146) TEST REPORT RESULT: EMERGENCY COOLDOWN CHECK VALVE ACCEPTANCE TEST FOR THE COLD FLOW DEVELOPMENT TEST SYSTEM. Lundberg, J. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 12 Jan 1965. 8p. Dep. NTIS $4.00.

The Emergency Cooldown Check Valve (ECCV) is used in the pump discharge line to prevent backflow to the turbopump when the emergency cooldown system is employed. An acceptance test of the ECCV to be used in the cold flow development test system was carried out. The valve, P/N 285994, S/N 0000005, was subjected to an ambient temperature proof test of 1500 psig. Then after being conditioned to LH_2 temperature, the valve was subjected to an external leak test and a cracking and reseat pressure test. The valve satisfactorily completed the three phases of testing and is acceptable for CFDTS usage. (auth)

24822 (RN-TM-0147) PREDICTED LH_2 PUMPING PERFORMANCE MARK III MOD 4 TURBOPUMP. Nishioka, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Jan 1965. 39p. Dep. NTIS $5.00.

Turbopump performance varies with inlet conditions, pressure rise, and flow rate. The predicted effect of inlet condition on the Mark III Mod 4 turbopump performance in relation to pressure rise and flow rate as well as some test data is presented. (auth)

24823 (RN-TM-0150) EFFECTS OF MODIFICATION TO DIFFUSER VANES ON MARK III MOD 4 PUMPING PERFORMANCE. Shigemoto, T. Y. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Jan 1965. 16p. Dep. NTIS $4.00.

In order to provide a larger minimum flow area during bleed-in (chill-down) conditions, a modification to the Mark III Mod 4 housing diffuser vanes was considered. The modification would consist of removing material from the leading edge of the present diffuser vanes. During the initial flow thru the pump (prior to drive pressure at the turbine) the pump impeller is not rotating, and flow exists radially from the radial impeller vanes. Consequently, the incidence angle at the diffuser vanes is high, and the resulting vena contracta flow area is below that at any other point in the engine. Therefore, for a period of time, choked flow occurs at the pump diffuser vane entrances. The modification to alleviate this restriction was analyzed for the effects on the other pumping performance relations. It was concluded that: The modification will not be detrimental to pumping performance at nominal conditions; the modification will not noticeably affect pumping performance so long as the free vortex pattern of discharge occurs; the stall limits of the Mark III Mod 4 turbopump with the modified diffuser vanes will occur at lower flows than that of the Mark III Mod 4 incorporating the standard diffuser vane configuration, and the modified diffuser has sufficient merit to be evaluated further during hydraulic tests. (auth)

24824 (RN-TM-0166) MARK III, TURBINE ASSEMBLY THERMAL ANALYSIS. Anton, D. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Sep 1965. 19p. Dep. NTIS $4.00.

The results of a thermal analysis run to determine the steady-state temperatures of the Mark III turbine are presented. Because of the uncertainty associated with the flow patterns of the bearing coolant once it reaches the main drive gas stream, two methods of analysis were used in determining gas recovery temperatures. The actual distributions will be between those obtained by these two extreme methods. This analysis was performed prior to the failure of TPA PN 287900-179 S/N 013 (first stage rotor) and temperature distributions have been published for the conditions of failure. The most severe thermal gradients are obtained by assuming that the bearing coolant flow mixes completely with the main drive gas before entering the first stage rotor rather than assuming that the coolant exists as a discrete layer while passing through the first stage rotor. (auth)

24825 (RN-TM-0334) ESTIMATED TURBOPUMP OPERATION DURING NRX/EST FLOW SHUTDOWN FROM FULL POWER. Nishioka, T.; Pframmer, R. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Mar 1966. 9p. Dep. NTIS $4.00.

During the shutdown sequence of the NRX/EST engine system an operating function known as "flow shutdown" is executed from a low power point. Events that are demanded during "flow shutdown" are as follows: Rotation of the reactor control drums to minimum reactivity position, closure of turbine power control valve (TPCV), opening of vent valve OVV 14, and opening of PCV 41 to admit coolant to the reactor. The resulting operation if initiated from a full power point would be abnormal. The analysis of the flow shutdown from full power condition shows that pump stall conditions and, possibly, a brief period of water hammer will occur. Due to the short time in stall, stall will not have detrimental effects on the turbopump. It is estimated that at the lowest flow rate during flow shutdown a water hammer effect will briefly occur. Whether the water hammer condition will cause harmful effects on the turbopump has not been conclusively established. (auth)

24826 (RN-TM-0353) PREDICTED MEASUREMENT UNCERTAINTIES, NRX-5. Samuelson, R. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 18p. Dep. NTIS $4.00.

A best estimate as to how well selected AGC parameters can be measured during NRX-A5 has been calculated. The data acquisition channels and transducers have been evaluated independently. Then, assuming a randomness in the performance of system components, channel and transducer uncertainty values were combined through a square-root-of-the-sum-of-the-squares (RSS) technique to provide a measurement uncertainty value for each parameter. Transducer performance is known from qualification testing and calibrations. System channel uncertainty values are taken from the results of a Test Cell "A" narrow band data acquisition accuracy evaluation test. The system uncertainty values used are both circuit and multiplexer oriented and possess a 99% confidence level. That is, the deviation of recorded data values from true parameter values will be less than the stated uncertainty limits 99% of the time. (auth)

24827 (RN-TM-0373) REMOVAL OF FISSION PRODUCTS FROM NERVA ENGINE EXHAUST GASES. Carter, J. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Aug 1966. 11p. Dep. NTIS $4.00.

Measurable area contamination has occurred following tests of NERVA I engines; with the future scale-up by a factor of about 5, contamination can be expected to become more serious and to extend to larger areas. Radioactive iodine is of particular con-

cern, because of its ready entrance into biological cycles. For this reason, the possibility has been examined of removing fission products from the hydrogen stream before releasing it to the atmosphere. Fission products are formed continuously during reactor operation, at the rate of approximately 225 grams per hour for a 5000 MW power level. Some of these fission products diffuse into the hydrogen stream almost as fast as formed; others are largely retained in the fuel beads and only enter the hydrogen stream as fuel elements are eroded away. The problem of removing these fission products from the gas stream is an extremely difficult one on account of the gaseous form, low concentration, large high velocity gas flows at high temperature, etc. It is concluded that a water mist spray of 9 cubic feet/sec. might be effective (this is far less than the amount of water needed for cooling), but experiments and pilot plant tests are recommended before full scale construction of such a system. (auth)

24828 (RN-TM-0378) ANALYSIS REPORT OF ENGINE VIBRATIONS MEASURED DURING THE NRX-A5 TEST SERIES. Rosser, R. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Oct 1966. 12p. Dep. NTIS $4.00.

Analyses of Vibration Data were conducted as a part of the NRX-A5 Final Report. The maximum measured nozzle accelerations were ± 21 g's indicated at start up. The nozzle-mounted accelerometer channels failed during part of the test, but this was at times when the nozzle vibrations were at lower levels than the ± 21 g. Sudden short bursts of high vibration, similar to those recorded on NRX/EST, were measured at the pressure vessel forward dome. These palpitations had a maximum magnitude of ± 20 g at 570 Hz and 925 Hz. Core support plate accelerations occurred up to ± 2.9 g longitudinal and 2.0 g radial, predominately at 370 Hz. Apparently, excessive heating from full power radiation destroyed the output of these accelerometers during the major portion of the test. Within a few seconds after flow shutdown their operation became normal and satisfactory. Control drum actuator accelerations in the longitudinal direction were ± 3.5 g maximum. (auth)

24829 (RN-TM-0426) TIME RESPONSE TEST OF THRUST CHAMBER THERMOCOUPLES IN SIMULATED ROCKET FIRING. Hoff, R. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Apr 1967. 10p. Dep. NTIS $4.00.

Simulated rocket firing tests were conducted for the purpose of accurately determining the time constant of a thrust chamber thermocouple in hot flowing hydrogen that simulates the heat transfer characteristics of the NRX thrust chamber gas at three specified engine operating conditions: 13, 44, and 100% of full power. This information is needed to determine the probe time constants for control loop dynamic stability purposes during low and intermediate power conditions. The highest heat transfer coefficient achieved was 63%. On the basis of tests run at 13, 45, and 63%, the following conclusions were reached: The time constant of each thrust chamber thermocouple is dependent on two factors, probe construction and the gas heat transfer coefficient; the lead bath determined time constant, previously used as the time constant for each thermocouple, is a valid representation of the probe time constant at full power and is a characteristic of the probe construction; the total time constant exceeds the 0.5-sec response requirement at engine power levels below 13% of full power; and the results are applicable to all thermocouples of this type based on the fact that the lead bath response time is a valid representation of the probe construction factor, and the gas heat transfer coefficient is the same for all probes of the same type. It is recommended, however, that additional tests be conducted to define the probe response characteristics below 13% of full power if the probes are to be used for engine control within this region. (auth)

24830 (RN-TM-0430) WELD PROCEDURE FOR REPAIR OF LARGE OPENINGS IN CYLINDRICAL SHELLS. Flens, F. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jun 1967. 12p. Dep. NTIS $4.00.

A revision of welding specifications for the repair of openings in 5000 psi gaseous hydrogen receivers is based on additional development work encountered in the repair of two cylinders using the previous specification. The new specifications are quite detailed. (LTN)

24831 (RN-TM-0572) AMENDED CALIBRATION DATA FOR XE-2 GAMMA HEATING RATE SENSORS (TE882 A, TE884 A, TE885 A, and TE886 A). Hoff, R. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Sep 1968. 13p. Dep. NTIS $4.00.

The calibration data for the gamma heating rate sensors (AGC 1134280) mounted on the XE-2 pressure vessel forward flange were based on the assumption that the thermal conductivity of constantan is constant with respect to temperature. This assumption has since been found to be incorrect, and the following amended calibration equation corrects the variation with temperature: $\gamma = .001028\ (T_1 - T_2)(1 + .000615\ [T_1 + T_2])$, where γ is gamma heating rate in watts/gram, T_1 is ball temperature in degrees Rankine (TE882 A or TE884 A), T_2 is base temperature in degrees Rankine (TE885 A or TE886 A). Gamma sensor data reduced with the amended equation will provide gamma heating rates within ± 10% accuracy. (auth)

24832 (TID/SNA-13) TEST FACILITY PERFORMANCE REQUIREMENTS FOR ETS-1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 44p. Dep. NTIS $5.25.

The performance requirements imposed upon the ETS-1 facility by the test article are identified and specified. Eventually, these requirements will be imposed by the NERVA Verification Plan, T-102, and in particular the associated Verification Information Sheets, VIS's. This document will be used to screen, interpret, and consolidate these requirements into a single source that combines all test-article-imposed facility performance requirements and the background information necessary for their implementation. Because the T-102 VIS's are not yet written, this initial draft is based upon Section 3 of the NERVA Engine Specification (Data Item C002-CP090290-F1). (auth)

24833 (TID/SNA-14) NRTO SUPPLEMENT TO NERVA PRODUCT ASSURANCE PROGRAM PLAN P017. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 73p. Dep. NTIS $6.75.

24834 (TID/SNA-16) MOCKUP AND SIMULATOR PROGRAM FOR NERVA. Shoemaker, F. M.; Burks, R. E.; Swain, R. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 24p. Dep. NTIS $4.25.

The need for, and requirements of, engine simulators and mockups to be used in the NERVA engine program are defined. The items are described, their usages detailed, and schedules provided in relation to design, development, test stand activation, and engine testing. During design of the engine it is necessary to provide mockups to aid the designers in the component packaging design, aid in the evaluation of maintainability requirements, and assist in the design of electrical harness and tubing routing. During development of the flight engine, it is necessary to develop and check out the auxiliary equipment and facilities required to test and maintain the engine. These facilities and equipment are GSE for handling and transport of the engine, GSE for engine maintenance actions, the test facility NASS duct, the test stand propellant feed system and the test stand I&C. In addition, the engine-to-vehicle (test stand) remote interface must be developed. Additionally, devices are needed to train operators of remote equipment in handling the engine and its maintainable components and modules. To fulfill the objectives of the program, a number of mockups and simulators are described specifically and their needs justified. (auth)

24835 (TID/SNA-17) RELIABILITY PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 103p. Dep. NTIS $8.25.

This reliability plan was prepared to implement those portions of reliability methodology that will optimize available resources in developing a highly reliable NERVA engine system. The general approach presented is: (a) to perform detailed system-and-component-level failure-mode and single-failure-point analyses, early in the systems-analysis phase, to identify critical modes of failure and trend characteristics; (b) to determine the priority rating of each failure-mode in terms of system criticality, probability of failure, and part weight, which will then determine the degrees of subsequent analysis and testing for each mode; (c) to implement a probabilistic approach to component design for these critical failure modes that will include statistical propagation-of-error analysis for engine-system state points and performance parameters; (d) to statistically design material and component testing; and (e) to apply rigorous failure reporting, analysis, and corrective-action procedures and trend analysis during the development phase. In general the methods and plans developed apply to analysis of the NERVA engine system as well as to each major subsystem and component within the engine. The approach presented is equally applicable to vehicle mission studies. The procedures needed to implement the reliability methodology are developed along with the maturing design process and are published as required throughout the program. (auth)

24836 (TID/SNA-18) NERVA VERIFICATION PLAN, PRELIMINARY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 87p. Dep. NTIS $7.50.

The Engine Verification Program is primarily designed to verify that the engine will satisfy all the requirements of the Engine Specification, CP 90290. In the main this will be accomplished by testing ground test configurations of the 75,000 lb thrust, full

flow cycle, and flight design nuclear rocket engine the detailed objectives and descriptions of such testing are given. Nine subsystems are listed which have their own verification plans which are coordinated with this overall integrated plan. (LTN)

24837 (TID/SNA-19) PRELIMINARY: MEASUREMENT DATA REQUIREMENTS LIST (NERVA OPERATIONAL FLIGHT ENGINE) FULL FLOW ENGINE. Dwg. No. 1137400 Rev. C, Dwg. No. 1137401 Rev. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 46p. Dep. NTIS $5.50.

In selecting the measurement data needed on an operational NERVA flight engine, the number of measurements needed has been minimized to save weight. Primary consideration has been given to those measurements required for the safe operation of the engine for the duration of the prescribed mission. Additional measurements will be needed for malfunction detection, trend data values, and control system checks, but definition of these items is not yet possible. (LTN)

24838 (TID/SNA-21) ENGINEERING DATA FOR INTERFACE CONTROL. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 90p. Dep. NTIS $7.50.

Engineering data for interface control of the various equipment in the NERVA engine are presented. The locations and interfaces of the various equipment items are identified and minimal dimensional definition is provided. The maturity of the information is dependent on the maturity of the overall design: items presented are consistent with the baseline flight engine. Detailed drawings for each item are included. (LTN)

24839 (TID/SNA-22) S038-CP090290-F1: DYNAMIC ANALYSIS REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 361p. Dep. NTIS $21.25.

The objective of the dynamic analysis is to determine the modal data of the engine, consisting of natural frequencies and mode shapes, and obtain the dynamic responses (deflections) at major subsystem/component interfaces as a result of specified external forces (forcing functions). Data obtained from the engine dynamic analysis is used to determine overall nuclear flight vehicle characteristics. In addition, the calculated dynamic loads and deflections will be used to review subassembly/component margins of safety and reliability that were based on static conditions to ensure continued structural adequacy. The dynamic analysis data also represents an important guide in planning of engine vibration tests. Engine modal data of all natural frequencies and associated plots of modal shapes for the launch condition, and for the space flight condition, are presented. One longitudinal, and three separate axes of lateral motion have been considered for each condition. (auth)

24840 (TID/SNA-23) THERMAL AND FLUID FLOW ANALYSIS REPORT FOR NERVA NOZZLE EXTENSION. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 132p. Dep. NTIS $9.75.

The NERVA nozzle extension constitutes the aft portion of the nozzle assembly subsystem. The extension interfaces with the nozzle at divergent area ratio 24 to 1 and extends as an optimum Rao contour to area ratio 100 to 1. The reference concept is an uncooled, laminated graphite structure (AGCarb-101). Backup concepts are hydrogen-cooled steel and aluminum structures. Detailed thermal and fluid flow analyses have been conducted to: Define and establish the performance and design requirements; establish and substantiate appropriate parameters; and provide the source for steady-state nozzle extension structural thermal data. The data relate to the full flow NERVA engine design, specifically to Nozzle Assembly Subsystem Drawing No. 1138000 which is part of the NERVA Flight Engine Drawing No. 1137400C. (auth)

24841 (TID/SNA-24) NERVA TRANSPORTATION MODES. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 40p. Dep. NTIS $5.00.

Evaluated in this trade study are the various methods of transporting an assembled NERVA engine. NERVA engine transportation and handling requirements and constraints were extracted from NPRD, Release No. 7, and engine specification CP 090290A, dated 8 September 1970. Assumptions were made regarding Trade Study 1004 (Engine Acceptance Test Method) and Trade Study 1009 (Poison Wire Removal and Reinsertion on Ground) because these trade studies have not been completed. Environmental accelerations were extracted from S-038 (Dynamic Analysis Report and Handling Shock Data) and applied in accordance with AEC 0529, Safety Standards for Packing of Radioactive and Fissile Materials. The above criteria were used to determine the acceleration mitigation and handling shock requirement of an engine shipping container. Shipping container design criteria were found to be independent of transport mode but were, rather, constrained by handling shock as defined by AEC. Four methods of engine transport (air, truck, rail, and marine) were analyzed and compared as to route, distance, travel time, personnel support requirements, cost of transporter, and total trip cost. The comparisons resulted in specific recommendations for NERVA engine shipments between the sites considered. (auth)

24842 (TID/SNA-26) ACCEPTANCE-TEST TRADE STUDY INTERIM REPORT. Unger, R. I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 97p. Dep. NTIS $8.00.

The purposes of this trade study are (1) to establish acceptance test criteria for the deliverable NERVA Flight Engine, and (2) to select the acceptance test, or combination of tests, that provide a high degree of confidence for demonstrating that the acceptance criteria are met. These criteria are those key characteristics (fit, form, function, and operation) of components, subsystems, and the engine which provide a basis for comparison or judgment that the deliverable engine is equivalent to engines that have successfully completed qualification testing. In determining the best acceptance test candidate(s) many other factors must be considered. These factors include safety considerations, test facilities, design impact, support equipment (TSE/AGE), support personnel, test location, associated logistics, and costs required to accomplish the acceptance test(s). In comparing the candidate acceptance tests these factors are weighed against the confidence level that a particular test, or combination of tests, provides. After considering many tests the conclusion is reached that, since the criteria have not been completely developed and all of the test related factors have not been assessed, no specific tests can be selected at this time. (auth)

24843 (TID/SNA-28) NERVA ENGINE SHIELD PENETRATION DESIGN STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 42p. Dep. NTIS $5.25.

This design study was conducted to investigate the feasibility of routing the engine turbine lines directly between the pressure vessel and the turbopumps with penetrations in the external shield. A possible improvement in engine design was weighed against the complexity and penalties associated with penetrating the shield. The results of the study concluded that the current engine design with the turbine lines routed around the external shield is more feasible. Design complexity, weight, engine performance, maintainability, reliability and the decisions contained in Change Order 70-8 (i.e., criteria requiring remote shield removal and replacement and elimination of the boost pumps) also contributed to substantiate the conclusion reached. (auth)

24844 (TID/SNA-29) REPLACEABLE SHIELD DESIGN STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 48p. Dep. NTIS $5.50.

Design Change Order 70-8 required the external shield to be remotely replaceable to allow conversion from manned to unmanned configurations. This design study was conducted to determine the most satisfactory general design approach for satisfying this requirement. The reference shield configuration, using lead for gamma shielding and mechanical means for remote replacement, was investigated and two shield/thrust structure concepts were developed. Alternate gamma shielding materials were also investigated with such material forms as powder, shot and liquid metal considered, and design concepts were developed for shield configurations with these alternates. The alternate materials offered the smallest penetration in the thrust structure for extraction of the central portion of the external shield. Comparisons of the various concepts were made with attention directed to weight, minimizing engine and AGE design complexity, relative simplification of remote space operations and maintaining the shield attenuation capability. The study concludes that the most satisfactory design approach is that afforded by the reference shield configuration using lead for gamma shielding and mechanical means for remote replacement. (auth)

24845 (TID/SNA-30) NERVA MANAGEMENT PLAN. Volume I. Management System. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 190p. Dep. NTIS $12.50.

The NERVA Management Plan specifies the management processes that will be used at all levels of management to direct, accomplish, and control all phases of the NERVA program. The management processes depicted in this plan will be audited by Program Controls for each function and output document shown on the logic diagrams to verify that responsibilities are adhered to in accordance with the Functional Responsibility Matrices. (auth)

24846 (TID/SNA-33) TIME LINE SHEETS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 50p. Dep. NTIS $5.50.

A detailed plan for a NERVA lunar mission is developed, with particular attention to the reactor operations involved. (LTN)

24847 (TID/SNA-36) EXHAUST DUCT PRELIMINARY DESIGN. Volume I. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. Contract SNP-1. 46p. Dep. NTIS $5.50.

The NERVA Altitude Simulation System (NASS) Exhaust Duct System (EDS) preliminary design package is submitted. It is supplemented with sufficient backup technical data to warrant recommendation that the final design be initiated. It states the PDR scope, defines the NASS EDS design criteria, describes the preliminary design, summarizes the scale model test results, summarizes the design analyses, and presents conclusions and recommendations. (auth)

24848 (TID/SNA-37) EXHAUST DUCT PRELIMINARY DESIGN. Volume III. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. Contract SNP-1. 142p. Dep. NTIS $10.25.

This preliminary draft of the NASS Exhaust Duct System Fabrication and Testing Specification, 210-3352-G-002, Section 13D, Attachment 1, is based on the EDS design requirements contained in SO57-DSO90221B-EA, EDS Design and Test Requirement Specification. The fabrication specification is in accordance with the CSI format as modified for application to the NRDS/ETS-1 modification task specifications. The suggested Special Conditions Section contains requirements peculiar to the EDS fabrication and installation, which are not covered in the general contractual documents, nor contained in the technical specifications. (auth)

24849 (TID/SNA-40) NERVA ALTITUDE SIMULATION SYSTEM. Exhaust Duct Preliminary Design (F008). Preliminary Aerodynamic and Thermodynamic Analysis, F008-NAS01-W224. Appendix A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1970. 247p. Dep. NTIS $15.50.

This volume includes, or references, all documents, reports, memoranda, and/or any other thermal or aerodynamic backup information pertinent to NASS design and which constitutes either testing or analysis performed in developing the design. Four areas of major consideration relative to the NASS duct are considered: (1) the primary ejector; (2) the turning plenum; (3) the secondary ejector; and (4) the overall NASS system. (auth)

24850 (TID/SNA-58) PRELIMINARY SYSTEM SAFETY ANALYSIS REPORT FOR NERVA ENGINE TEST SYSTEM (CHAPTERS 1 THROUGH 5). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. Contract SNP-1. 97p. Dep. NTIS $8.00.

The safety aspects of the NERVA engine test program are described. At present, the program includes tests of seven (7) NERVA engines and/or engine/stage assemblies at ETS-1 and E/STS-2 between January 1975 and April 1980. The test series provides for two development engines, two prequalification engines, and three qualification engines. The test facilities at the Nuclear Rocket Development Station are described, with special attention to safety aspects and the safety program. (auth)

24851 (TID/SNA-68) ECONOMIC SPACE SYSTEMS ANALYSIS. Waldo, R. D. (Aerojet-General Corp., Azusa, Calif. (USA)). [nd]. 18p. Dep. NTIS $4.00.

An initial attempt is made to use economic methods in choosing between 3rd stage chemical and 3rd stage nuclear rockets for a few missions. (LTN)

24852 (TID/SNA-86) TECHNICAL CONFERENCE AT NORAIR (RE: SR-150) ON NOVEMBER 19, 1959. White, L. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Dec 1959. 4p. Dep. NTIS $4.00.

Declassified 8 Jan 1970.

A 1959 technical conference between Norair and Aerojet representatives on nuclear propulsion, chemical propulsion and mixed chemical and nuclear propulsion (in separate stages) is reported briefly. Weights, propellants, thrusts, payloads, recoverability of boosters, etc. were discussed. The rockets involved were discussed extremely briefly and without any cost data. (LTN)

24853 (TID/SNA-88) NERVA ENGINE MATERIALS PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 28p. Dep. NTIS $4.50.

This plan sets forth revised methods for the application of materials and material processes in the NERVA Program. Its purpose is to assure that materials meet performance requirements within known and specified degradation limits. Its scope applies to the entire NERVA Program. Its implementation requires continuing surveillance and control of all aspects of materials work at the Aerojet-General Corporation Facility, at NERVA Test Operations, Nuclear Rocket Development Station, at major subcontractors, and at the plants of primary suppliers. The plan encompasses all phases of materials applications, ranging from conceptual design, component development, and hardware fabrication to the continuing feedback of information from operating experience and tests. The plan emphasizes a strong material effort early in the design cycle to prevent development of materials problems. The purposes are to review all materials to assure reliable performance of components and the engine system on all missions; to provide materials properties data for design use by publication of the "NERVA Materials Properties Data Book (AGC Report 2275)" or Data Release Memoranda; to provide traceability by documentation of all materials decisions, including those concerning applicability of materials for service, test results, and the review of design, specifications, and drawings; and to verify that the approval of drawings meets the requirements of established checkoff procedures and that stress calculations have been based upon valid properties data. (auth)

24854 (TID/SNA-89) 75K NERVA THERMAL AND FLUID FLOW ANALYSIS REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 53p. Dep. NTIS $5.75.

Detailed thermal and fluid flow analyses have been carried out to substantiate appropriate parameters as defined in the NERVA engine specification, and to support other design analysis work by providing the source for steady-state and transient engine structural thermal data. The data are for the full flow NERVA engine design and are current to the date of issue. Thermal and fluid flow conditions expected after launch during coast (solar soak) and steady-state full power operation for 60 minutes continuous duration are documented. (auth)

24855 (TID/SNA-90) DILUENT AND BOLT-COOLANT FLOWS FOR THE NERVA HOT-BLEED ENGINE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1970. 99p. Dep. NTIS $8.00.

The diluent system must be capable of supplying hydrogen to the bleed-port insert in sufficient quantity to reduce the temperature of the hot-bleed gas taken from the nozzle chamber to a level that will not damage the turbine or turbine inlet lines. The purpose of this trade study was to select the optimum diluent supply system and to determine whether the nozzle bolt coolant circuit could be flowed in series with the diluent circuit. Three systems were analyzed: (1) diluent taken from the pressure-vessel dome; (2) diluent taken from the reflector inlet with forward-flow bolt coolant; and (3) diluent taken from the reflector inlet with reverse-flow bolt coolant. In spite of some advantages favoring the taking of diluent from the reflector inlet, the system which takes diluent from the pressure-vessel dome is recommended because of the difficulties of obtaining a good bootstrap start using the colder hydrogen from the reflector inlet. (auth)

24856 (TID/SNA-91) 75K NERVA ENGINE FULL-FLOW MASS PROPERTIES ANALYSIS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1970. 84p. Dep. NTIS $7.25.

The mass properties of the 75,000-lb-thrust NERVA engine, its subsystems, and components are described as of 19 December 1969, and depicted by Aerojet-General Drawing 1136390, "A" change. The engine uses the full-flow principle to drive twin turbopumps. The nuclear subsystem is contained within an aluminum pressure vessel. A stainless-steel nozzle expands to an area ratio of 100:1 with an extension constructed of graphite reinforced with graphite fiber. Radiation shielding is provided both inside and outside the pressure vessel. A 10,000-lb allowance is provided in the engine weight for the external shield, which approximates man-rating for missions as presently defined. The engine's current total dry weight is 36,604 lb. (auth)

24857 (TID/SNA-95) SPECIFICATION AND PERFORMANCE SUMMARY FOR REFERENCE ENGINES (VACUUM CONDITIONS). (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Jul 1961. 1p. Dep. NTIS $4.00.

Declassified 16 Oct 1968.

24858 (TID/SNA-96) ROVER CONFERENCE, WEEK OF 17 MARCH 1968, AEROJET-GENERAL CORP. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Apr 1958. 24p. Dep. NTIS $4.25.

Declassified 25 Nov 1966.

A propellant feed system (for liquid hydrogen and with controls) for the KIWI-B reactor experiment was considered as a company design and development task and work statements, agreements and schedules were drawn up after conferences with LASL and other interested companies. (LTN)

24859 (TID/SNA-98) PRESSURIZATION AND ACTUATOR GAS REQUIREMENTS FOR NERVA HOT BLEED ENGINE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1970. 277p. Dep. NTIS $17.00.

The function of the pneumatic supply subsystem (PSS) is to

satisfy pneumatic requirements with gas at a regulated pressure during a mission as follows: (1) to pressurize the main propellant tank (MPT); (2) to operate the thrust vector control (TVC) actuators; (3) to operate engine valves; and (4) to satisfy leakage requirements. Mission requirements have been determined from the NPRD as detailed in the NERVA Mission Data Book. As the satisfactory achievement of these four engine stage requirements is essential to the completion of a mission, the PSS must be capable of operation with a high reliability, maximum safety, and minimum weight. Various alternative pneumatic subsystems have been investigated in terms of performance in three typical missions. The subsystem selected as optimum is described and the reasons for the selection are presented. (auth)

24860 (TID/SNA-99) CHAMBER-PRESSURE-OPTIMIZATION TRADE STUDY FOR THE FULL-FLOW NERVA ENGINE. Houghton, W. J. (ed.). (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Mar 1970. 104p. Dep. NTIS $8.25.

Three engine components are most significantly involved in establishing limitations and development difficulties: The nozzle, the reflector, and the reactor core. The nozzle must be designed to handle higher heat loads as chamber pressure is increased. This is done by causing the propellant velocities to increase with chamber pressure. The limit on this design process is a cold-side Mach No. of 0.3. This nozzle heat-transfer limit restricts the chamber pressure to below 480 psia. The reflector must support a large, radially inward pressure difference between propellant in the coolant passages at the entrance to the reflector and the pressure at the core exit, which is chamber pressure. This is a large pressure difference because it includes the pressure drop across the turbine. It is accentuated by the malfunction requirement to sustain full power on one turbopump. The resultant stress loading makes the reflector design difficult at a chamber pressure of 450 psia and even more severe as chamber pressure is increased above 450 psia. Some of the core support depends on high-temperature structural members. The creep of some of these members is increased when chamber pressure is reduced because this causes an increase in the pressure drop across the core axially. The creep problem results in a need for a chamber pressure no lower than 450 psia. Therefore, a chamber pressure of 450 psia has been selected for the NERVA full-flow engine. (auth)

24861 (TID/SNA-102) FEASIBILITY DEMONSTRATION OF A 90mm HYDROSTATIC RADIAL BEARING FOR A HYDROGEN TURBOPUMP APPLICATION. Phase II. November 1969–January 1970. Roesch, E.; Accinelli, J. B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1970. 52p. Dep. NTIS $5.75.

The results of the follow-on phase for a 90mm liquid hydrogen journal bearing program to demonstrate the feasibility of such a system for a hydrogen turbopump application are presented. The previously used tester was utilized to demonstrate the effect of design improvements of the hydrostatic test bearing, specifically in terms of load capacity. The results indicate the feasibility of hydrostatic bearings for LH_2 NERVA turbopump applications. A full-scale program directed toward development/qualification of an operational turbopump shaft support system is recommended. It is concluded that such a program should concentrate on developing the operational capability of the system (start/shutdown and transient behavior) for the turbopump duty cycle requirements. (auth)

24862 (TID/SNA-104) EPIC ENVELOPE TRADE STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 36p. Dep. NTIS $5.00.

The EPIC is a key electrical system of the I&C subsystem providing the integrating function for all the I&C electronics. It weighs about 600 lbs and requires several hundred interconnections with other instruments and components. The EPIC is responsible for diagnostic and control activity which will enable checkout operations and which will maintain engine performance within design parameters required for completion of mission objectives and/or which will report malfunctions and perform to contingency plans for emergency situations under malfunction conditions. The objective of this trade study is to determine the cable weight savings which might be achieved by mounting EPIC on the engine vs on top of the tank. It was concluded that the tank top location for EPIC is best since location below the tank results in a severe weight penalty. The weight accrues from the shielding required to reduce the radiation environment for EPIC to a level which EPIC can be demonstrated to reliably withstand. (auth)

24863 (TID/SNA-105) ENGINE ELECTRICAL POWER SOURCE TRADE STUDY. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 25p. Dep. NTIS $4.25.

The purpose of this study was to determine if it was feasible for the engine to generate its own electrical power through an alternator. The recommendation is that an alternator not be incorporated. The reasons are: The alternator provides no advantage over other sources, it poses a reliability penalty to the engine gas system, it poses a weight penalty, and it presents battery development problems. (auth)

24864 (TID/SNA-122) NERVA PRODUCT ASSURANCE PROGRAM PLAN P-017. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Mar 1970. 89p. Dep. NTIS $7.50.

The Product Assurance Program Plan describes the system used to assure the compliance with the quality requirements of the SNP-1 contract as described in Quality Program Provisions for Space System Contractors, NPC 200-2, and supplemented by the NERVA Program Requirements Document, SNPO-NPRD-1. The plan is described in detail. (LTN)

24865 (TID/SNA-125) R201-CP090290-F1: MAINTAINABILITY ALLOCATIONS, ASSESSMENTS, AND ANALYSIS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1970. 91p. Dep. NTIS $7.75.

The results of a maintainability analysis are summarized. The current design satisfies the specified maintainability requirements of the NERVA engine specification CP-090290. The modular grouping of the maintainable components on the current engine provides accessibility and simple installation and removal movements for remote maintenance operations. Based upon reliability predictions, none of the modules contain components which would cause excessive module maintenance. Maintainability predictions based upon both current predicted reliability and allocated reliability indicate that it is unlikely that any specific maintainable component would fail during the engine life. NERVA Engine maintenance will consist of corrective maintenance or replacement based on the condition of the item. A direct correlation does not exist between ground and space maintenance times, and, until space equipment and facilities are defined, there will be no validity in space maintenance time estimates or maintainability parameter predictions. Consequently, additional analysis work in these areas will not be conducted until space operations are defined in sufficient detail. (auth)

24866 (TID/SNA-126) M001-STR04-W234ald SUMMARY REPORT CY 1970. For Period Ending 30 September 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 536p. Dep. NTIS $30.00.

Notable activities in the development of nuclear propulsion are summarized. Fueled-reactor tests were first conducted in 1959 and the most recent engine tests were completed in 1969. Extensive fundamental research has been performed in investigating space materials, radiation effects, and the complex computer codes required to predict engine operation and behavior. The NERVA engine testing program has: 1. Demonstrated the ability of a reactor to operate for a period of 1 hr (NRX-A6). 2. Demonstrated the ability of a reactor/pressure vessel/nozzle assembly to attain a specific impulse of 825 sec (Pewee 1). 3. Demonstrated the ability of a reactor/pressure vessel/nozzle assembly to develop a thrust of 75,000 lb (Phoebus 1B). 4. Demonstrated engine stability over a wide range of operating conditions (NRX/EST and XE-Prime), with start and restart capability both successfully demonstrated. 5. Demonstrated the successful performance (XE-Prime) of a hot-hydrogen-driven turbopump with liquid-hydrogen-lubricated bearings (8000 hp was developed at a liquid-hydrogen flow rate of 75 lb/sec). Many details of research and development results, test operations, radiation effects, etc. are given in this 536 page summary report. (auth)

24867 (TID/SNA-127) NERVA ENGINE PURGE UNIT REQUIREMENTS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1970. 40p. Dep. NTIS $5.00.

The propellant feed system (PFS) specification requires a provision for purging the PFS with inert gas during all ground, launch and boost operations. This purge is necessary to achieve the inertness required to protect the engine system from chemical attack causing material degradation, hydrogen-oxygen explosions, or icing-caused bearing freeze-up or dynamic seal stickage, etc. It was determined that system inertness level requirements are as follows: maintain a moisture level of 15 PPM by volume or less, a total condensible gas level of 1 percent by volume, and limit chlorine, fluorine, and acetic acid to 2 micrograms per gram each or less. A study of several purge systems and methods was made. The candidate systems were analyzed quantitatively for purge time, amount of purge gases consumed and the best combination of purge gas to achieve minimum required system cleanliness level. (auth)

24868 (TID/SNA-133) t119-TFC-W129-02: DUAL TURBOPUMP TESTING IN TEST CELL C. Final Report. Andrews,

F. X.; DiLorenzo, F. L.; Nishioka, T. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 266p. Dep. NTIS $16.50.

The Dual Turbopump Test Program was conducted at Test Cell C during the second quarter of Contract Year 1970. The objectives of the program were successfully accomplished: Performance and operating characteristics data were obtained to upgrade steady-state and transient models, and for component design (including pump, turbine, valve, and line hydro-aerodynamics, component fluid and mechanical interactions, and malfunction and transient response). Centrifugal pumps will provide the flow range necessary for dual-TPA engine operation; stable operation can be achieved with the ΔP vs W_p slopes which are practical for centrifugal pumps; stable operation can be accomplished with pump flow rate differences (asymmetry) of 10 lb/sec (12½%); control of the system during normal operation and malfunction transients can be achieved without significant problems; malfunctions in the turbine drive control valves can be survived; a turbopump malfunction or failure can be survived; shutting down one TPA by closing the turbine block valve (TBV) results in a transient which can be survived. (auth)

24869 (TID/SNA-143) S-131, S131-CP090290-F1: NERVA MATERIALS PROGRAM PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 35p. Dep. NTIS $4.75.

This plan sets forth methods to assure that materials meet intended performance requirements. The plan emphasizes a strong materials effort early in the design cycle to prevent material problems and decision delays that jeopardize delivery and cost of reliable hardware by optimizing design criteria with material properties. The plan is in response to SNPO-C Data Item Description S-131, Revision B, NERVA Materials Program Plan, 1 February 1970. This document requires definition of how the contractor proposes to: evaluate applicability of materials for each component to assure reliable performance; provide materials properties data in the NERVA Materials Properties Data Book for design, disseminate materials properties data and maintain historical records; provide the program with materials traceability; maintain a Materials Verification List for review of drawings; and provide an annual material program that indicates priorities and maturity of data. The plan applies to the entire NERVA program, including components, engine system, ground support, and facilities. (auth)

24870 (TID/SNA-156) SUBCONTRACT WORK STATEMENT. Supplementary Agreement No. 7. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 May 1968. Contract NP-1. 143p. Dep. NTIS $10.25.

A detailed statement is provided of the NERVA research and development programs to be carried out during the contract year October 1, 1967 through September 30, 1968. (LTN)

24871 (TID/SNA-176) RELIABILITY AND QUALITY ASSURANCE INFORMAL PROGRESS LETTER NO. 47A FOR FOURTH QUARTER, CY 1968 COVERING JULY, AUGUST, AND SEPTEMBER 1968. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1968. 25p. Dep. NTIS $4.25.

Quarterly progress in reliability and quality assurance is discussed. Particular items are failure mode analysis of specific items, reliability studies, fuel element tests, statistical reports of work, etc. (LTN)

24872 (TID/SNA-184) TRADE STUDY REPORTS, S054-S5090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 322p. Dep. NTIS $19.25.

Twelve trade study reports involving NERVA engine design properties, characteristics, operation, testing, etc., are bound together. (LTN)

24873 (TID/SNA-193) RELIABILITY AND QUALITY ASSURANCE INFORMAL PROGRESS LETTER NO. 41A FOR SECOND QUARTER, CY 1967 COVERING JANUARY, FEBRUARY, AND MARCH 1967. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1967. 43p. Dep. NTIS $5.25.

Specific items in contractor surveillance, reliability, quality assurance, etc., on which work was done during the quarter are discussed briefly. (LTN)

24874 (TID/SNA-198) STUDY TO DEVELOP A TOXIC MATERIALS CONTROL PROGRAM FOR THE APOLLO EXTENSION SYSTEMS (AES) PROGRAM. (Aerojet-General Corp., Azusa, Calif. (USA)). Jul 1965. 58p. Dep. NTIS $6.00.

Trace contaminants will be contributed to the atmosphere inside a manned spacecraft by materials of construction and by the crew. Some of these may be toxic if permitted to build up in the cabin and others may be quite undesirable. Based on work already performed, a program is recommended to (a) develop specifications for space craft materials to minimize toxic contaminants, (b) make recommendations for a toxic materials control program and (c) describe possible research and development programs. A list of 100 possible toxic contaminants (mostly low boiling organics) is given with properties, probable source and threshold limit value. On-board removal systems are discussed briefly. (LTN)

24875 (TID/SNA-201) FACILITIES FOR KIWI B FLOW CONTROL SYSTEM DEVELOPMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 May 1958. 6p. Dep. NTIS $4.00.

Declassified 20 Aug 1968.

A request for the consideration of (1) other facilities at an Air Force Base, (2) smaller facilities and (3) less expensive and less flexible facilities for flow tests in support of KIWI B reactor tests is answered. It is estimated that 1500 high flow tests involving GH_2, GHe, GCH_4 and LH_2 will be required to complete development and conduct acceptance testing of the control valves and actuators, standard nozzles and flow meters, shut-off valves and actuators, check valves and the control loop system. This will take over a year on a two shift/day basis in the previously planned facilities, involving high capacity pumps and extensive available company support and maintenance. The cost is estimated at over $500,000. It is estimated that it would cost more to do this work at an Air Force base (due to AF costs and remoteness to company facilities), take longer in less expensive, less flexible facilities, etc. Further, the previously proposed facilities will have other foreseen future uses. (LTN)

24876 (TID/SNA-202) NUCLEAR ROCKET ENGINES USING KIWI B REACTOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 29 Jul 1960. 10p. Dep. NTIS $4.00.

Declassified 23 Aug 1968.

Schematic diagrams of nuclear rocket engines with four different types of propellant feed systems are presented, along with a graph comparing the calculated specific impulse versus chamber pressure for each type. The types of feed system considered are: topping cycle, "cold" bleed cycle, "hot" bleed cycle and chemical gas generator. (LTN)

24877 (TID/SNA-204) WEEKLY SUMMARY OF PROGRESS ON ROVER PROJECT. Rumbold, S. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Sep 1957. 35p. Dep. NTIS $4.75.

Declassified 23 Aug 1968.

Various weekly progress reports for the ROVER reactor for the fall of 1957 have been bound together. Among other things, nuclear and chemical rockets are considered, hydrogen and ammonia are compared as propellants, experiments on the removal of heat at high temperature are under way, trajectory calculations are under way, turbopump studies are in progress (especially bearings), and control equipment is being investigated. Some other items are discussed briefly and several reports are being prepared. (LTN)

24878 (TID/SNA-205) PROPERTIES OF HYDROGEN USED IN HYDRAULIC CALCULATION FOR TOPPING CYCLE PRELIMINARY DESIGN. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Sep 1957. 1p. Dep. NTIS $4.00.

Declassified 21 Aug 1968.

24879 (TID/SNA-207) TYPICAL START TRANSIENT (TOPPING CYCLE). (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 May 1961. 1p. Dep. NTIS $4.00.

Declassified 21 Aug 1968.

24880 (TID/SNA-208) [PROPULSION ASPECTS OF BAC FINAL REPORT ON SR-183: QUESTIONS AND ANSWERS]. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Nov 1959. 6p. Dep. NTIS $4.00.

Declassified 3 Dec 1969.

A review committee, consisting mostly of Air Force people, had received in 1959 a Boeing report on rocket propulsion for space and moon applications and then set up a meeting to ask questions about the conclusions, schedules, etc., reached in the report. The questions and answers are reviewed here in the form of brief minutes of the meeting. (LTN)

24881 (TID/SNA-209) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ELECTRONIC, POWER, INSTRUMENTATION, AND CONTROL. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 37p. Dep. NTIS $5.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Engine Electronic, Power, Instrumentation and Control (EPIC), hereinafter referred to as the EPIC. The EPIC provides an aggregate of modular electrical/electronic assemblies to be used for engine control, signal processing and electrical supply distribution. (auth)

24882 (TID/SNA-223) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PUMP DISCHARGE

CHECK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Pump Discharge Check Valve and Actuator (PDKV) Assembly. The PDKV Assembly shall be capable of preventing backflow to the pump during engine malfunction operating mode. (auth)

24883 (TID/SNA-224) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR ENGINE INSTRUMENTATION. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 9p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Engine Instrumentation. The engine instrumentation shall be capable of monitoring engine parameters such as pressures, temperatures, vibrations, strains, and displacements and converting these physical parameters into equivalent electrical signals for diagnostic, control, and trend data purposes. (auth)

24884 (TID/SNA-226) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR INSTRUMENTATION AND CONTROL SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 29p. Dep. NTIS $4.50.

Specifications are established for the performance, design, test and qualification requirements of equipment identified as the Instrumentation and Controls Subsystem. This subsystem provides an aggregate of electromechanical and electrical/electronic devices and assemblies to be used for sensing engine phenomena, signal transmissions, engine control, signal processing and electrical source conditioning and distribution. Other listed documents, of the latest issue, form a part of this specification to the extent specified herein. (auth)

24885 (TID/SNA-227) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR THRUST STRUCTURE SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 15p. Dep. NTIS $4.00.

Specifications are established for the performance, design, test, and qualification requirements of equipment identified as the Thrust Structure Subsystem. Other documents, of the exact issue listed, form a part of this specification to the extent specified herein. (auth)

24886 (TID/SNA-228) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR GIMBAL ASSEMBLY SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 21p. Dep. NTIS $4.25.

Specifications are established for the performance, design, test, and qualification requirements of equipment identified as the Gimbal Assembly Subsystem. This subsystem consists of a gimbal pivot and a gimbal actuator. Other listed documents, of the exact issue listed, form a part of this specification to the extent specified herein. (auth)

24887 (TID/SNA-229) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR GIMBAL ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 9p. Dep. NTIS $4.00.

Specifications are established for the performance, design, test, and qualification requirements of the Gimbal Actuator. The gimbal actuator forms a part of the Gimbal Assembly Subsystem and is listed as a design critical component in detail specification EC-90244. The gimbal actuator consists of an electrical amplifier, an actuator motor, a linear drive mechanism, and a feedback network. Other listed documents, of the latest issue, form a part of this specification to the extent specified herein. (auth)

24888 (TID/SNA-230) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR LOWER THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 8p. Dep. NTIS $4.00.

Specifications are established for the performance, design, test and qualification requirements of equipment identified as the lower thrust structure. It is a part of the subsystem described as the thrust structure subsystem and is listed as a design critical component in detail specification EC-90152. Other listed documents, of the latest issue, form a part of this specification to the extent specified herein. (auth)

24889 (TID/SNA-232) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR WIRING HARNESS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 8p. Dep. NTIS $4.00.

24890 (TID/SNA-233) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR UPPER THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 8p. Dep. NTIS $4.00.

24891 (TID/SNA-234) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR EXTERNAL SHIELD SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

24892 (TID/SNA-239) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PUMP DISCHARGE LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 16p. Dep. NTIS $4.00.

This specification establishes the performance, design, test, and qualification requirements for equipment identified as pump discharge lines (PDL). The PDL transports propellant from the turbopump discharge to the nozzle torus inlet and to the inlet of the structural support coolant line. (auth)

24893 (TID/SNA-240) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR NOZZLE SKIRT EXTENSION. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 7p. Dep. NTIS $4.00.

24894 (TID/SNA-243) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR MIDDLE THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 8p. Dep. NTIS $4.00.

24895 (TID/SNA-244) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR DESTRUCT SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

The Destruct Subsystem shall be capable of (a) destruction of the reactor core and dispersal of the fueled components in the event of a mission abort prior to orbit injection of the nuclear vehicle. (b) Upon successful injection of the nuclear stage into orbit, being manually or automatically removable from the vehicle and the Destruct Subsystem shall be operational from launch until nuclear stage injector into earth orbit. (auth)

24896 (TID/SNA-245) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PRESSURE VESSEL AND CLOSURE SUBSYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 15p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as the pressure vessel and closure subsystem (PVCS). The PVCS shall be capable of containing the high pressure hydrogen propellant fluid which flows from the nozzle through and around the enclosed reflector to the internal shield. The subsystem shall be capable of functioning as specified at rated operating conditions without degradation before and after being subjected to the transient conditions associated with startup, shutdown and cooldown of the NERVA engine. (auth)

24897 (TID/SNA-247) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR PROPELLANT SHUTOFF VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 13p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Propellant Shutoff Valve and Actuator (PSOV) consisting of a valve and an electro-mechanical actuator system. The PSOV assembly is to be used to permit flow of liquid hydrogen to the turbopump assembly during engine operation and to prevent flow prior to and after engine operation. (auth)

24898 (TID/SNA-249) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE INLET LINE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Dec 1969. 14p. Dep. NTIS $4.00.

This specification establishes the performance, design, test and qualification requirements for equipment identified as turbine inlet line (TIL). The TIL transports propellant from the pressure vessel discharge to the turbine inlet and to the inlet of the turbine bypass line. (auth)

24899 (TID/SNA-261) S054-026, S054-CP090290-F1: ENGINE THROTTLING, STARTUP AND SHUTDOWN RAMPS, AND CHILLDOWN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 54p. Dep. NTIS $5.75.

During operation, the NERVA engine produces radioactive materials that produce decay heat and require cooldown after engine shutdown. During cooldown, thrust generation and propellant consumption are not at maximum efficiency; specific impulse is only about 500 sec as compared with 816 sec at rated operation. It is, therefore, desirable to minimize the use of propellant in the cooldown mode. This can be done by throttling

the engine to lower thrust and power levels for some period prior to shutdown to allow decay of some of the fission products produced at full I_{sp}. As engine life is limited to 10 hr at operating temperature, there are trade-offs among such items as effective I_{sp} and engine life. In addition, lower-thrust operation can result in trajectory losses from operation of the stage at reduced accelerations in a gravity field. However, under some conditions, and for some missions, a net gain results from a period of throttled operation. Several studies of engine operation have been made with the idea of optimizing benefits from the engine by proper choice of operation. (auth)

24900 (TID/SNA-264) MAINTAINABILITY: IN FLIGHT AND GROUND. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 69p. Dep. NTIS $6.50.

The summarized results of a maintainability study are: The current engine design should provide for replacing all valves, actuators, and turbomachinery through maintenance actions. To simplify replacement operations and reduce the number of joints and connections, components are to be integrated into related modules. The capability to replace the engine on the vehicle in space appears to be the most important maintenance capability to be provided because the resulting extension of the nuclear ferry life affords significant opportunities for reducing program costs. It may also prove more cost effective to change engines to accommodate the different shielding requirements of manned or unmanned missions than by modifying the shield configuration of an engine mounted on the vehicle. The capability to replace the engine must be accounted for in designing the engine-vehicle interface and must be provided for in the space support equipment and facilities. Major cost expenditures would be justified to achieve fast, simple engine replacement. It is not cost effective to maintain the engine to provide an extended life by replacing a module containing the reactor on the rest of the engine, as the program hardware cost reduction does not appear to exceed the cost of providing this maintenance capability. Maintainability guidelines for engine and component configuration design were developed by considering nuclear engine maintenance during ground testing, maintenance on the launch pad, and maintenance in space. These guidelines emphasize easy replacement of components and are listed. (auth)

24901 (TID/SNA-268) GIMBAL ACTUATOR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. Contract SNP-1. 98p. Dep. NTIS $8.00.

The results of studies leading to the concept selection for the NERVA Engine Gimbal Actuator are presented. As presently conceived, two gimbal actuators and the gimbal pivot assembly combine together to form the engine gimbal system. The actuators provide a means of thrust vector position control about the pitch and yaw axes either singularly or in any vector combination. The preliminary results indicate that a slow responding engine gimbal system is adequate within the scope of the reference missions. A two part trade study was conducted to assist in the selection of subassembly concepts which both satisfy these TVC requirements and meet other supplementary functional requirements. The first was to investigate major elements of the servo actuator in a conventional manner by assuming a singular mechanical subassembly in each actuator. Concepts were evaluated on the basis of performance, reliability, safety, potential growth, maintainability, cost and schedule. The second was to investigate various mechanical redundancy schemes as a means of reducing sources of single point failures. Schemes were evaluated on the basis of the failure modes analysis technique. (auth)

24902 (TID/SNA-278) QUARTERLY PROGRESS REPORT, SECOND QUARTER CY 71 PROJECT 187. Materials and Processing Development Activities, Second Quarter 1971. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1971. 115p. Dep. NTIS $8.75.

Materials and process development activities are reported. Materials development topics include: (1) "Materials Properties Data Book" revision of AISI 347 data; (2) property data development reports, the subjects of which include tensile, flexural fatigue, thermal expansion and thermal conductivity properties of AISI 347, tensile properties of AA7073-T73 and K-Monel, fracture toughness and thermal conductivity properties of Ti-5Al-2.5Sn(ELI), thermal conductivity of AA7039-T63, specific heat of Brass 268, 3% transformer steel and beryllium copper, thermal expansion of bronze; and the thermal radiation properties of an Al_2O_3 coating on an aluminum alloy substrate; (3) fracture toughness at -320°F of irradiated Inconel 718, Ti-5Al-2.5Sn(ELI) and AA7039-T63; (4) a computer simulation study evaluating the problem of statistically defining category "A" design allowables from two material lots; (5) planning of future material development activities; and (6) material and process selection for the NASS ejector L-channel. Component support topics include: (1) low-cycle fatigue testing of candidate nozzle materials AISI 347 and Hastelloy X, as well as creep tests on AISI 347; (2) a summarization of the evaluation of candidate materials and thermal control coatings for the pressure vessel; (3) fracture toughness testing of the turbopump material, Ti-5Al-2.5Sn(ELI) and evaluation of 440C bearings, (4) evaluation of candidate mating materials for use in the actuator slip brake; (5) flexural fatigue and endurance limit of AA6061-T6 lines material; and (6) evaluation of the properties of fibrous-graphite woven structures and composites. (auth)

24903 (TID/SNA-324) NERVA ENGINE CEI SPECIFICATION. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1968. 91p. Dep. NTIS $7.75.

This specification establishes the requirements for the performance, design, test and qualification of equipment identified as the NERVA Nuclear Rocket Engine, Contract End Item (CEI) No. 90194. This CEI, hereinafter referred to as the engine, is used as a source of primary propulsive power for space vehicle applications to fulfill missions specified in Appendix B of the NERVA Program Requirements Document, SNPO-NPRD-1. This engine is a variable thrust, turbopump-fed, hot-bleed cycle, nuclear-powered rocket engine, utilizing hydrogen as the propellant, and designed to operate at a vacuum thrust level of 75,000 pounds and at a specific impulse of 823 seconds with a contoured nozzle expansion ratio of 90:1. This CEI requires externally supplied liquid hydrogen, electrical power and command signals. (auth)

24904 (TID/SNA-325) NERVA MAINTAINABILITY PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Nov 1968. 39p. Dep. NTIS $5.00.

The NERVA Program Requirements Document (SNPO-NPRD-1) establishes the maintainability criteria and stipulates that a Maintainability Program and Program Plan be provided in accordance with AFSCM/AFLCM-310. The AFSCM/AFLCM-310 Data Item R-102 states that the Maintainability Program shall comply with MIL-STD-470, which specifies the minimum activities considered essential to assure the achievement of the required NERVA engine reliability. A cross-index has been provided to show the relationship between program tasks and (1) applicable specifications or standards, (2) other reference documents, and (3) company procedures and controls. Maintainability is a characteristic of the design and installation which is expressed as the probability that an item will be retained in, or restored to a specified condition within a given period of time when maintenance action is performed in accordance with prescribed procedures and resources. The Maintainability Program is structured to assure the incorporation of the necessary maintainability characteristics in the detail design of engine and support equipment. The principles are applied throughout all phases of the engineering and development effort. The objective is twofold: To incorporate the elements of maintainability into the design, and to monitor the development effort and iterate maintainability considerations as necessary. The elements of Maintainability will be incorporated by designing to prevent human-induced failures. The components, subassemblies, and assemblies will be designed to allow accessibility for servicing, testing, inspecting and replacing units, as well as to minimize the requirements for recalibration. Another element of Maintainability to be included is design for failure isolation capability, where applicable. (auth)

24905 (TID/SNA-326) NERVA RELIABILITY ALLOCATIONS, ASSESSMENTS, AND ANALYSIS REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1968. 75p. Dep. NTIS $6.75.

The initial reliability analysis of the reference NERVA flight engine, nonnuclear subsystem (NNSS) is presented. The major components and subsystems were considered. The report includes engine-system failure modes and attendant predicted failure probabilities, a presentation of the crew-safety and population-hazard aspects of the engine, a definition of related mathematical models, apportionment of the system reliability goal, and conclusions and recommendations. Though detailed design definition was lacking, the study was still conducted to provide a framework for future engineering and reliability studies, to acquaint personnel in various program disciplines with the total reliability picture, and to acquire information as early as possible for decision making on program policies and planning. (auth)

24906 (TID/SNA-332) BUDGET ESTIMATE: 1971 NERVA DEVELOPMENT PROGRAM. Volume II. Narrative Descriptions by Project. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 155p. Dep. NTIS $10.75.

Narrative descriptions are provided for each project in the CY 1971 budget estimate, with CY 69 accomplishments and expected results for CY 70 and CY 71. (LTN)

24907 (TID/SNA-333) BUDGET ESTIMATE: 1971 NERVA DEVELOPMENT PROGRAM. Volume I. Agency Budgets, FY 1971. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1969. 391p. Dep. NTIS $22.75.

The financial part of the FY 1971 NERVA Development Program budget is presented in great detail, includes costs for 1968, 1969 and 1970, and is broken down in several ways. (LTN)

24908 (TSCS-ATP-008) TSCS ACCEPTANCE TEST PROCEDURE FOR NERVA ENGINE. ETS-1 Engine Control System. Issue 5. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Mar 1967. 42p. Dep. NTIS $5.25.

24909 (TSCS-ATP-009) TSCS ACCEPTANCE TEST PROCEDURE FOR NERVA ENGINE. Racks 64 and 65 (Checkout System). Issue 5. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Mar 1967. 37p. Dep. NTIS $5.00.

24910 (UCRL-50447) LOW-POWER REACTOR SYSTEMS STUDY. Garelis, E.; Podney, W. N.; Koponen, B. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jul 1968. Contract W-7405-eng-48. 63p. Dep. NTIS $6.25.

Declassified 4 Sep 1973.

A study that was made to establish preliminary design characteristics of low-power reactors for space power systems is described. The study considered power systems ranging from 20 to 150 kW(e) with a maximum lifetime of 5 years. Design criteria were based on the use of current refractory alloys and ceramic fuel technology because of the system availability requirement for the mid- to late-1970's. Brayton cycle, Rankine cycle, thermoelectric, and thermionic power conversion schemes were considered and studied. (auth)

24911 (WANL-TME-787) ADEQUACY OF TCA INSTRUMENTATION, DATA ACQUISITION, AND DATA REDUCTION SYSTEMS FOR NRX-A2 TESTING. Corl, C. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jun 1964. 100p. Dep. NTIS $8.00.

The NRDS Test Cell "A" instrumentation, data acquisition and data reduction system is described as it pertains to the scheduled NRX-A2 reactor test. Based on all present data requirements and inventories (attached), the NRDS facilities are adequate for performing NRX-A2. One possible area of difficulty is that of low level solid state multiplexers which must be borrowed from LASL to insure adequate performance of the data acquisition system. Although no modifications to existing facilities are necessary other than those already planned for the NRX-A2 test, presently known data requirements for NRX-A3 indicate that some additional facilities must be made available for that test. (auth)

24912 (WANL-TME-793) PROPOSAL TO PERFORM TRANSFER FUNCTION MEASUREMENTS OF THE PARKA CRITICAL FACILITY REACTOR AT LASL BY CROSS-CORRELATION WITH A PSEUDORANDOM INPUT SIGNAL. Hafer, J. F.; Wasserman, A. A.; Honka, E. K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 May 1964. 24p. Dep NTIS $4.25.

The purposes of the proposed experiment are to: (1) check out the use of cross-correlation techniques with small-amplitude, binary input signals of predetermined statistical properties produced by a feedback-shift-register signal generator, to perform measurements of reactor transfer functions associated with drum reactivity perturbations; (2) perform an independent measurement of the low-power reactor transfer function in order to experimentally determine the reduced prompt-neutron generation time of a ROVER-type reactor for comparison with calculated values; (3) perform an independent measurement of the transfer function of an installed, hydraulic, ROVER-type control drum actuator for comparison with results obtained by sinusoidal oscillation techniques; (4) determine the relative advantages (i.e., measurement accuracy, frequency-band coverage, etc.) to be gained from applying the pseudo-random input signal outside the control loop (i.e., as a power-demand signal) as compared to applying the signal inside the control loop (i.e., as a drum-position-demand signal); and (5) gain hardware experience in the measurement of transfer functions by the cross-correlation technique using the WANL signal generator, in preparation for measurements of this type during the NRX-A2 tests. (auth)

24913 (WANL-TME-959) INTERIM REPORT ON THE RE-ENTRY BEHAVIOR OF THE NERVA REACTOR. Grob, L. H. Jr.; Trammell, M. R. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Oct 1964. 75p. Dep. NTIS $6.75.

Two experimental investigations have been conducted. The first was performed to determine the aerodynamic characteristics of an intact reactor on re-entry. The second to gain a qualitative idea of the re-entry burn-up characteristics under typical heat flux conditions. The following preliminary conclusions were drawn: The reactor has regions of static stability. In the absence of initial angular velocities, the reactor stabilizes at a positive 5 degrees angle of attack. The larger the initial flight path angle, the greater is the peak aerodynamic heating during re-entry. Titanium pressure vessels require higher heat fluxes for disassembly than aluminum pressure vessels. Reactor disassembly appears to be most rapid for a side first re-entry. No fission product diffusion will occur due to re-entry heating. (auth)

24914 (WANL-TME-1040) QUALIFICATION SPECIFICATIONS FOR CONTROL DRUM PNEUMATIC ACTUATORS FOR XE-1 APPLICATION. Hornberger, D. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Nov 1964. 46p. Dep. NTIS $5.50.

Declassified 9 Jun 1966.

The tests which Control Drum Pneumatic Actuators must pass for qualification for XE-1 use are described. (LTN)

24915 (WANL-TME-1040(Rev.A)) QUALIFICATION SPECIFICATIONS FOR CONTROL DRUM PNEUMATIC ACTUATORS FOR XE-1 APPLICATION. Burke, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Nov 1967. 31p. Dep. NTIS $4.75.

The environmental tests and expected performance of the XE-1 Control Drum Pneumatic Actuator for qualification are specified. The actuator is to be subjected to the various environments expected in the XE Test Series while its performance as a control system component is evaluated. Among the tests to be performed are vibration and shock which shall qualify the actuator for both ground handling and anticipated ground firing conditions. The actuator shall also be tested for operation at low temperatures. The low temperature tests shall consist of both uniform temperature throughout the actuator and localized cooling at various points on the actuator housing. To determine the life expectancy of the actuator, a continuous operation for 150 hours followed by one hour operation at low temperature and under expected ground firing vibration is to be performed. The results of the NRX-A6 Side-by-Side Test and the NASA Lewis AG-20 and XE-1 irradiating tests will serve to qualify the actuator for use in a radiation environment. (auth)

24916 DEVELOPMENT COSTS FOR A NUCLEAR ELECTRIC PROPULSION STAGE. Mondt, J. F. (Jet Propulsion Lab., Pasadena, CA); Prickett, W. Z. pp 167-172 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

Development costs are presented for an unmanned Nuclear Electric Propulsion (NEP) Stage. The NEP Stage employed in this study is based upon a liquid metal cooled, in-core thermionic reactor. A total of 120 kW(e) are delivered to the thrust subsystem which employs mercury ion engines for electric propulsion. This study represents the most recent cost evaluation of the development of a reactor power system for a wide range of nuclear space power applications. These include geocentric, and outer planet and other deep space missions. The development program is described for the total NEP Stage, based upon specific development programs for key NEP Stage components and subsystems. These include the power subsystem: the reactor, shield, EM pumps, accumulators, and the primary radiator; the thrust subsystem: the ion engine array, power conditioning, and the low temperature heat rejection radiator; the propellant subsystem: the mercury propellant, tanks and distribution system; and the avionics subsystem: guidance, communications and control. The development program that is defined provides one flight NEP Stage. Costs are identified for type acceptance (qual), ground prototype add technology development hardware. Flight nuclear safety, systems engineering and program management and control cost elements are presented. Maximum use is made of cost data from recent ongoing or related programs. These include the AEC Thermionic Reactor Program, ion engine development at NASA-Lewis and the Jet Propulsion Laboratory, liquid metal component development programs sponsored by both NASA and the AEC, and nuclear safety costs identified for flight programs such as Apollo (SNAP-27). Estimated NEP Stage development costs are $275M (including $35M for the first flight NEP Stage), plus $35M required for facilities. Subsequent flight NEP Stage units could be about $25M each. (auth)

24917 MULTI-MISSION NUCLEAR ELECTRIC PROPULSION STAGE DESIGN. Prickett, W. Z. (General Electric Co., Philadelphia); Stearns, J. W. pp 159-166 of 8th Intersociety

Energy Conversion Engineering Conference Proceedings. Addendum. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

The results of a mission engineering analysis of nuclear-thermionic electric propulsion spacecraft for unmanned interplanetary and geocentric missions are summarized. Critical technologies assessed are associated with the development of Nuclear Electric Propulsion (NEP), and the impact of its availability on future space programs. Specific areas of investigation include outer planet and comet rendezvous mission analysis, NEP Stage design for geocentric and interplanetary missions, and technology requirements for NEP Stage development. A multimission NEP Stage can be developed to perform both multiple geocentric and interplanetary missions for a 1983 launch. Identified pacing NEP technology requirements are the development of 20,000 full power hour ion thrusters and thermionic reactor, and the development of related power conditioning. The resulting NEP Stage design provides both inherent reliability and high payload mass capability. High payload mass capability can be translated into both low payload cost and high payload reliability. NEP Stage and payload integration is compatible with the Space Shuttle. (auth)

24918 SATELLITE NUCLEAR POWER STATION: AN OPTION FOR FUTURE POWER GENERATION. Williams, J. R.; Clement, J. D. pp 566-573 of 8th Intersociety Energy Conversion Engineering Conference Proceedings. New York; American Inst. of Aeronautics and Astronautics (1973).

From 8th intersociety energy conversion engineering conference; Philadelphia, PA (13 Aug 1973).

A new concept in nuclear power generation is being explored which essentially eliminates major objections to nuclear power. The Satellite Nuclear Power Station, remotely operated in synchronous orbit, would transmit power safely to the ground by a microwave beam. Fuel reprocessing would take place in space and no radioactive materials would ever be returned to earth. Even the worst possible accident to such a plant should have negligible effect on the earth. An exploratory study of a satellite nuclear power station to provide 10,000 MW(e) to the earth has shown that the system could weigh about 20 million pounds and cost less than $1000/KW(e). An advanced breeder reactor operating with an MHD power cycle could achieve an efficiency of about 50% with a 1100°K radiator temperature. If a hydrogen moderated gas core reactor is used, its breeding ratio of 1.10 would result in a fuel doubling time of a few years. A rotating fluidized bed or NERVA type reactor might also be used. The efficiency of power transmission from synchronous orbit would range from 70% to 80%. The only environmental effect of this power plant would be a slight thermal discharge at the receiving antenna, equal to about 10% of the heat released by today's most efficient power plants. Thus, the Satellite Nuclear Power Station comes close to the ideal of providing power without pollution at an acceptable cost. (22 references) (auth)

24919 AN INVESTIGATION OF FUEL-MODERATOR COMBINATIONS FOR THERMAL THERMIONIC REACTORS IN SPACE CRAFTS. Sahin, S. (Karadeniz Teknik Universitesi, Trabzon (Turkey)). Atomkernenergie; 24: No. 2, 89-94(1974).

4 figs.; 6 tabs.; 25 refs.

Under the aspects of space flight ^{233}U and ^{235}U were investigated as fuel and $ZrH_{1.7}$Be as moderator for thermal thermionic reactors. In order to achieve a high accuracy in this work, all neutron physics calculations were carried out with the help of multigroup S_N methods. 123 energy groups, S_4-P_3 approximation by one dimensional and 4 energy groups, S_4-P_1 approximation by two dimensional calculations have been used. It is shown that $^{233}U/ZrH_{1.7}$ type reactors have the most compact construction and the ^{235}U/Be and $^{235}U/ZrH_{1.7}$ type reactors are competing with each other regarding their technical performance, on the other hand ^{233}U/Be type reactors are too bulky for the present state of space crafts. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 22053, 22542, 22613, 22621, 22638, 22662, 22959, 23384, and 25110.

24920 (AED-CONF-74-474-001) TECHNICAL RULES AND REGULATIONS IN THE FIELD OF REACTOR SAFETY. Berg, K. H. (Bundesministerium des Innern, Bonn (F. R. Germany)). 1974. 27p. (In German). INIS.

From 3rd German symposium on atomic energy law; Goettingen, F. R. Germany (22 Oct 1974).

There clearly is a need for a special, technical set of rules and regulations in the domain of reactor safety. Hence it has been proposed that the Kerntechnische Ausschuss (KTA) (Nuclear technical committee) be given the task to collect and/or define rules and regulations for reactor safety in all those fields where there is unanimity in the judgement of experts and manufacturers, operators, and regulatory authorities, and to promote the application of such rules in practice. (GE)

24921 (AED-CONF-74-474-002) THE NUCLEAR SUPPLYING INDUSTRY IN THE DOMAIN OF NONLIABILITY DUE TO THE CHANNELING OF RESPONSIBILITIES. Gnam, P. (Siemens A. G., Erlangen (F. R. Germany)). 1974. 6p. (In German). INIS.

From 3rd German symposium on atomic energy law; Goettingen, F.R. Germany (22 Oct 1974).

Available from ZAED.

A bill introduced by the German Federal Government concerning a third law for the amendment of the German Atomic Energy Law adopts the principle of the so-called channeling of responsibilities; the liability for nuclear damage is exclusively concentrated on the owners of a nuclear power plant. It is pointed out that this will turn out to be disadvantageous for the nuclear industry vendors. (GE)

24922 (AED-CONF-74-474-004) GOVERNMENT BILLS CONCERNING THE RATIFICATION OF THE EUROPEAN CONVENTIONS ON THIRD PARTY LIABILITY IN THE FIELD OF NUCLEAR ENERGY AND IMPROVEMENTS OF THE GERMAN ATOMIC ENERGY LAW. Pfaffelhuber, J. K. 1974. 20p. (In German). INIS.

From 3rd German symposium on atomic energy law; Goettingen, F. R. Germany (22 Oct 1974).

Available from ZAED.

A Government bill for the ratification of the Paris and Brussels Conventions on Third Party Liability in the Field of Nuclear Energy, and another bill concerning a third law for the amendment of the existing Atomic Energy Law are discussed. Both bills are intended to reshape the present regulations to make them meet the requirements and standards of modern technology in the atomic sector. (GE)

24923 (ANL-Trans-971) OUT-OF-PILE MELTING OF URANIUM OXIDE. Amblard, M. Jan 1975. Translation of SM-190/26. (CONF-741030-6). 11p. Dep. NTIS $4.00.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

As a part of fast reactor safety studies, the problem of interaction between the molten fuel and coolant prompted development of several experimental devices allowing a variable amount of uranium oxide to be molten and contacted with liquid sodium in different configurations. The following experiments were performed: (1) dropping a few grams of UO_2 into a small volume of sodium; (2) spraying a few grams of molten UO_2 under high pressure on metal assemblies; (3) melting a 7 g UO_2 bar by the Joule effect and allowing a study of the interaction under a sodium pressure (JEF experiment); (4) injection of a small amount of sodium into 7 kg of high-frequency-melted UO_2 (CORECT I); and (5) interaction under pressure of 7 kg liquid UO_2 with 100 l sodium (CORECT II). (auth)

24924 (BAW-10098) CADDS: COMPUTER APPLICATION TO DIRECT DIGITAL SIMULATION OF TRANSIENTS IN PWRs WITH OR WITHOUT SCRAM. Hsii, Y. H.; Busby, S. E. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1975. 60p.

The CADDS digital computer code is used to analyze reactor transients, with or without scram, in a heterogeneous pressurized water reactor. It solves the time-dependent neutron kinetics equations in conjunction with a thermal-hydraulic solution for an average fuel pin during a reactivity transient. The simulation includes the major feedback mechanism as well as detailed single-phase nucleate boiling, transition, and stable film boiling core heat transfer models. The entire reactor coolant loop, including the pressurizer, is simulated. The steam generator model is included to evaluate the effect of feedwater variations on the steam generator as well as the primary system response. (auth)

24925 (BMFT-FBK-74-02) 300 MW PROTOTYPE OF NUCLEAR POWER STATION WITH FAST SODIUM-COOLED REACTOR SNR. Supplementary Project "Engineered Safeguards". Final Report. Jegoroff, L. (comp.). (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). Nov 1974. 179p. (In German). Dep. NTIS (US Sales Only) $12.00.

Details on the work completed within the framework of the SNR-Engineered Safeguards I program are presented. Categories included basics, decay heat removal, shut-down system, and

instrumentation and control systems. The subjects of the program which have not been completed were continued in the SNR-R+D program. (auth)

24926 (BNWL-1875) PREDICTION OF FISSION GAS RELEASE FROM UO_2 FUEL. Beyer, C. E.; Hann, C. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1974. Contract AT(45-1)-1830. 54p. Dep. NTIS $7.60.

High and low temperature gas release models were developed to provide an improved method for predicting gas release from UO_2 fuel because of the important role of fission gas release in LWR safety calculations. The high temperature release model was fit to a consistent and well characterized set of 45 data points using a multiple linear regression code. The low temperature release model is compatible with the high temperature model (i.e., extends gas release predictions to temperatures below 1200°C where the high temperature model is not applicable). The conclusions reached are: (1) The high temperature gas release model fits the data well with a correlation coefficient of 0.980 and a standard deviation of 4.7 in percent release; (2) in the operating range of current design light water reactors, previously proposed high temperature release models are more conservative (i.e., predict larger gas release fractions) than the model developed here; (3) power histories, large axial power gradients, and fuel temperature estimates seem to be the major factors which cause the large variance among gas release data. A definite reduction in the variance results if the above parameters are controlled; (4) burnup and density have no detectable influence on high temperature gas release over the range 400 to 18,000 MWD/MTM and 91.3 to 98.0% theoretical density; and (5) experimental data indicate that low temperature gas release increases with increasing burnup for burnups greater than 20,000 MWD/MTM. (auth)

24927 (BNWL-B-391) PARAMETRIC STUDY OF TEMPERATURE, PRESSURE, AND BURNING RATE RESULTING FROM LARGE SODIUM POOL FIRES IN THE CSE CONTAINMENT VESSEL. Cooke, R. L. Jr.; Trent, D. S.; Postma, A. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-1830. 40p. Dep. NTIS $4.00.

A parametric study was conducted to determine the effect of sodium burning conditions on the temperature, pressure, and sodium burning rate in the CSE containment vessel. The study was needed to determine the maximum range of the physical parameters in the scheduled large scale sodium aerosol tests. The study was conducted as part of the RSR sponsored program: "Experimental Studies of Aerosol Behavior Associated With Low Probability Accidents in an LMFBR." For the expected values of experimental parameters, average gas temperature as high as 360°F, and pressures as high as 4.5 psig were predicted. During the burn period, considerably higher temperatures were reached in the fire plume. The dominant heat input comes from the heated burn pan rather than the fire itself. The predicted temperatures and pressures were found to be well within the design ratings of the vessel, and the predicted streamlines resulting from the fire are expected to be helpful in selecting locations for particle samplers in the containment vessel. (auth)

24928 (CONF-740578-1) QUALITY ASSURANCE. Program Report. Goetz, V. (Atomic Industrial Forum, Inc., New York (USA)). Oct 1974. 49p. Atomic Indus. Forum Inc., New York $10.00.

From AIF workshop on quality assurance; Minneapolis, Minnesota, USA (7 May 1974).

Summaries are presented of major points of workshop sessions dealing with (1) quality assurance in the reactor licensing process, (2) current and planned codes, guides, and standards, (3) recent initiatives in certification and inspection, (4) power plant reliability through quality assurance, and (5) the need for universal acceptance and understanding of quality assurance methods and goals. (DG)

24929 (COO-2152-14) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATIONS. Quarterly Progress Report, Period Ending December 30, 1974. Weisman, J. (Cincinnati Univ., Ohio (USA). Dept. of Chemical and Nuclear Engineering). [nd]. Contract AT(11-1)-2152. 17p. Dep. NTIS $4.00.

Research on pressure drop and heat transfer phenomena of importance during a loss of coolant accident is reported. The work includes: (1) transient pressure drop investigation, (2) two-phase pressure drop and flow pattern study, and (3) transition boiling and reflooding heat transfer tests. (JWR)

24930 (EPA-660/2-74-089) WATER RECYCLE/REUSE POSSIBILITIES: POWER PLANT BOILER AND COOLING SYSTEMS. Nelson, G. R. (National Environmental Research Center, Corvallis, Oreg. (USA)). Dec 1974. 57p. GPO.

The methodology to evaluate, in economic terms, potential power plant boiler and cooling system water recycle/reuse programs is presented. Drum type boiler systems and closed cycle cooling systems are used as the basis for the programs' water requirements. The evaluations take into account the variable plant characteristics such as makeup water quality, fuel type, thermal efficiency, capacity factor and fixed charge rate. The evaluation methodology is applicable to existing and proposed power plants, on an individual plant basis — and can be used to determine the over-all economics of potential recycle/reuse programs. (auth)

24931 (EURFNR-1184) SIMULATION OF TRANSIENT SODIUM-COOLED FAST BREEDER REACTOR FUEL PIN BEHAVIOR TAKING INTO ACCOUNT SPECIAL BURNUP FACTORS. Kuczera, B. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Mar 1974. Translation of KFK-1964. 138p. Dep. NTIS $10.00.

Thesis. Submitted to Karlsruhe Univ. (TH) (F. R. Germany). Work performed under United States-Euratom Fast Reactor Exchange Program.

The behavior of LMFBR-fuel pins under transient overpower conditions is examined. The main objective is to find out the influence of characteristic burnup phenomena upon the short-time behavior of fuel pins. The BREDA-II model is based on the equations of linear thermoelastic theory. In particular, the axisymmetric plane strain approximation is applied for the mechanical analysis. The multi-region fuel model allows description of long-time and transient burnup phenomena. The long-time irradiation effects considered are steady state fuel swelling, change in fuel porosity, and production and partial release of fission gases. Of particular importance is the transient fission gas release which leads to a pressure increase in the central void and hence to additional loads in the fuel pin. Transient fuel swelling can be modelled. Irradiation dependent changes of the cladding material properties do strongly influence the fuel pin performance and are discussed together with the fuel pin failure criteria. A comparison of the model calculations with experimental results of the H3-test (TREAT) shows good agreement of the transient fuel pin deformations. This largely supports the model concept which is based on a linearly elastic type behavior of the fuel. The fuel pin behavior is extrapolated to conditions which may arise during a hypothetical overpower whole core accident simulated by a 5/sec reactivity ramp insertion. Effects of burnup levels on the transient behavior are discussed within this investigation. (auth)

24932 (GA-A-12045(Add.2)) ADDENDUM 2: QUALIFICATION OF FORT ST. VRAIN SAFE SHUTDOWN EQUIPMENT FOR STEAM ENVIRONMENT RESULTING FROM PIPE RUPTURES. Burwell, E. J. (General Atomic Co., San Diego, Calif. (USA)). 8 Oct 1974. Contract AT(04-3)-633. 38p. Dep. NTIS $4.00.

An ASCO four-way solenoid valve and two Manatrol pneumatically actuated directional control valves are being considered as alternatives for the existing System 91 solenoid-actuated valves. A thermal analysis was performed to determine if testing in air would be acceptable in lieu of a steam environment. It was concluded from the analysis that testing in an air environment would subject the test articles to a thermal response identical to that resulting from testing in steam. Each of the prospective components was subjected to a skin-temperature profile equal to or greater than that attained during previous steam environment testing of similar components. The current testing was performed in a medium-size, externally heated, multipurpose autoclave. The test articles were individually inserted into a high-temperature air environment, and their skin temperatures were closely monitored to duplicate the required profile. Each component was actuated at specific intervals during the temperature transient. Test data were accumulated on each specimen before, during, and following the temperature transient. (auth)

24933 (GA-A-13191) GAS TURBINE HTGR POWER PLANT CONTROL AND SAFETY STUDIES. Quarterly Progress Report, July 1-September 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 20 Nov 1974. Contract AT(04-3)-167. 171p. Dep. NTIS $7.60.

This research program for the design and analysis of the Gas Turbine High-Temperature Gas-Cooled Reactor (GT-HTGR) encompasses (1) design and analysis of the plant and its control system, (2) evaluation of plant safety, and (3) specification of the requirements for certain facilities which will be used to test and/or develop various GT-HTGR materials, components, and combinations of components. During the quarter-year covered by this report, intense efforts were made and significant results were obtained in the following areas of interest: (1) Redefinition of the engineered safeguards for the GT-HTGR; (2) Preliminary assessment of the safety hazards associated with

mechanical failure of the turbomachine rotor or its elements and determination of shielding which would eliminate or at least greatly reduce these hazards. (3) Examination of the effectiveness of various helium coolant bypass configurations as means for control while, at the same time, limiting transient temperatures in power conversion loop components. (4) Review of the international state of knowledge regarding turbine materials suited for use in the GT-HTGR and implementation of a test program designed to allow the timely final selection of these materials. (auth)

24934 (GA-A-13210) GCR SAFETY PROGRAM. Quarterly Progress Report for the Period July 1, 1974–September 30, 1974. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1974. Contract AT(04-3)-167. 20p. Dep. NTIS $4.00.

Tasks in the program include seismic studies, HTGR accident initiation and progression analysis, GCR component and system reliability data bank, safety liaison, and HTGR safety research. (JWR)

24935 (INIS-mf-1383, pp 92-93) APPLICATION OF THE ITERATIVE METHOD TO THE NUMERICAL SOLUTION OF SOME NONSTATIONARY PROBLEMS FOR GAS COOLED REACTORS. Arifmetchikov, E. F. 1973. (In Russian).

An iteration method is described for the solution of implicit three-point grid equations with a form approximating the differential hydraulic equations (equations of continuity and motion), differential energy equations, and differential heat conductivity equations, with boundary conditions which for one-loop reactor installation with gas-cooled reactors are the conditions of periodicity. The method was used for the calculation of non-steady processes in installations of this type. (tr-INIS)

24936 (INIS-mf-1383, pp 100-101) SET OF PROGRAMS FOR CALCULATION OF NONSTATIONARY PROCESSES IN GAS COOLED NUCLEAR PLANTS. Arifmetchikov, E. F. 1973. (In Russian).

The characteristics of two programs ART-20 and ART-10 are briefly described. The first is designed for the calculation of the spatial-time distributions of gas and temperature parameters of fuel loops in a closed one-loop reactor installation in non-steady regime and the other for the calculation of the unsteady circulation of gas in a closed loop. The programs are written in ALGOL. (tr-INIS)

24937 (KFK-2036) SOME CONSIDERATIONS ON THE DEVELOPMENT OF A CORE CATCHER OF A GAS-COOLED FAST REACTOR. Barleon, L.; Dalle Donne, M.; Dorner, S. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe (F.R. Germany). Projekt Schneller Brueter). Feb 1974. 9p. (EUR-4977e; AED-CONF-74-450-001). INIS.

From specialist meeting on gas-cooled fast reactor safety; Karlsruhe, F.R. Germany (21 Feb 1974).

With abstract in English and German.

The calculation of the temperature and heat flux distributions in the core melt is very important for the choice of the materials to be used for the core catcher. Short-time transient calculations allow the estimation of the temperature at the boundary between core catcher and melt. The relatively slow instationary processes produced by the decay heat are considered as quasi-stationary, and temperature distributions are calculated for various power densities. For the calculation of the stationary temperature and heat flux distributions, it is assumed that natural convection is fully established and that solid and liquid layers are formed according to the temperature profile. The results of the calculations show that, due to the formation of two layers of oxide fuel, one solid and one of stagnant liquid respectively, only a small portion of the decay heat can be absorbed by the core catcher. The possibility of using graphite as core catcher constituent material is dealt with. Two types of emergency cooling are investigated: the so called dry cooling, without the introduction of a supplementary coolant; and the wet cooling, with the introduction of a supplementary liquid coolant, such as a molten salt. (GE)

24938 (KFK-EXT-28/74-2, pp v) MELTDOWN BEHAVIOUR OF LWR FUEL RODS. Hofmann, P.; Holleck, H.; Hagen, S. 1974. (In German).

From annual colloquium of the Projekt Nukleare Sicherheit; Karlsruhe, F. R. Germany (19 Nov 1974).

In annual colloquium of the Projekt Nukleare Sicherheit.

In the event of a cooling failure, e.g. by a rupture of the primary coolant pipe, it must be ensured that the afterheat is lead off safely from the reactor core without it coming to failure of the fuel elements. Should the extreme improbable case occur that the emergency cooling system should fail simultaneously with the main cooling system, then as a result of the strong production of heat in the fuel and at higher temperatures also by the exothermal zircaloy/steam reaction, a partial or total meltdown of the fuel elements and the reactor core units would take place. The object of this investigation is to describe the melting procedure phenomenologically, and to be able to characterize the thus occurring phases regarding their composition and melting points. (GE)

24939 (NDS-16) CHECK VALVE REQUIREMENTS ANALYSIS (PRELIMINARY). Sodium Valve Technology Program. Dever, J. E.; Price, D. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Apr 1969. 18p. Dep. NTIS $4.00.

An outline of design and performance requirements for large valves used in LMFBR primary and secondary loops is presented. (JWR)

24940 (NEDO-20732) MARK III CONFIRMATORY TEST PROGRAM. Seventh Quarterly Progress Report. Bilanin, W. J. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Dec 1974. 49p.

Within the General Electric Company there is an ongoing effort to develop analytical models capable of simulating the various phases of the Mark III pool swell phenomenon. Documentation of the progress that has been accomplished to date is presented. Detailed design of the Mark III system is proceeding on the basis of the dynamic loading information generated during the Pressure Suppression Test Facility (PSTF) air tests. Comparisons of the data with the results of the models are included in this report together with a discussion of the applicability of the data to the Mark III system. At this time it can be concluded that the pool swell phenomenon and the resulting impact loads on structures above the pool are amenable to analytical simulation, and that significant progress has been made in developing such models that are capable of duplicating the experimental data. (auth)

24941 (NP-20158) NUCLEAR POWER STATION AT CARNSORE POINT CO. WEXFORD. The Social, Economic, and Environmental Implications. (Junior Chamber of Commerce, Wexford (Ireland)). 1974. 60p. Dep. NTIS (US Sales Only) $6.00.

Following introductory and historical sections, the report is in chapters entitled: power from nuclear sources; public health aspects; local economy, services and communications; agriculture; fish and wildlife; tourism, sport fishing; scenery, flora and general amenity. The conclusions of the Study Group are strongly in favor of the project. (UK)

24942 (ORNL-TM-4729(Vol.1)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE DIVISION OF REACTOR SAFETY RESEARCH FOR JULY–SEPTEMBER 1974. I. Light-Water-Reactor Safety. (Oak Ridge National Lab., Tenn. (USA)). Dec 1974. Contract W-7405-eng-26. 85p. Dep. NTIS $5.45.

Progress is reported in the following areas of study: (1) blowdown heat transfer, (2) fission product beta and gamma energy release, and (3) zirconium-water oxidation kinetics. Operations at the Nuclear Safety Information Center are reviewed. Planned multirod burst tests, LWR fuel fission product release studies, and Zircaloy cladding creepdown and collapse investigations are described. (DG)

24943 (ORNL-TM-4831) MONTHLY HIGHLIGHTS FOR REACTOR SAFETY DIVISION PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1974. Contract W-7405-eng-26. 27p. Dep. NTIS $4.50.

Brief highlights are presented for the following: (1) heavy section steel technology program, (2) fission product beta and gamma energy release, (3) LOCA release from LWR fuel, (4) multirod burst tests, (5) Nuclear Safety Information Center, (6) PWR blowdown heat transfer, (7) Zircaloy fuel cladding collapse, (8) zirconium metal–water oxidation kinetics, (9) transient release from LMFBR fuel, and (10) HTGR safety analysis and research. (JWR)

24944 (ORNL-TM-4832) MONTHLY HIGHLIGHTS FOR REACTOR SAFETY DIVISION PROGRAMS AT OAK RIDGE NATIONAL LABORATORY. Fee, G. G. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1974. 29p. Dep. NTIS $4.50.

Research progress is briefly summarized for the following: heavy section steel technology program; fission product beta and gamma energy release; LOCA release from LWR fuel; multirod burst tests; Nuclear Safety Information Center; PWR blowdown heat transfer; zircaloy fuel cladding collapse studies; zirconium metal–water oxidation kinetics; transient release from LMFBR fuel; and HTGR safety analysis and research. (JWR)

24945 (ORNL-tr-2901) MEASUREMENTS OF TEMPERATURE NOISE SIGNALS AT THE OUTLET OF FUEL ELEMENTS FOR DETECTION OF BLOCKED COOLING CHANNELS. Krebs, L.; Weinkoetz, G. (Kernforschungszentrum Karlsruhe (F.R.

Germany). Inst. fuer Reaktorbauelemente). [nd]. Translation by R. G. Mansfield of Paper 71. (CONF-731020-4). 12p. Dep. NTIS $4.00.

From international heat transfer meeting; Karlsruhe, F.R. Germany (9 Oct 1973).

The development of a method for detection of blocked cooling channels in sodium cooled reactors by interpreting the statistical temperature signal from a thermocouple at a fuel subassembly outlet is described. Some preliminary measurements made in the KNK reactor are discussed. (JWR)

24946 (RCN-220) LOSS-OF-COOLING CAPSULE IN THE HFR-PETTEN (DESCRIPTION AND SOME EXPERIMENTAL RESULTS). Klerks, W.; van der Kleij, N. (Stichting Reactor Centrum Nederland, Petten). Oct 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

As a part of the SNR safety studies, the consequences of a local cooling flow disturbance were simulated under SNR conditions (560°C sodium temperature; 560 W/cm linear power production) in a LOC-capsule. Subjects of interest are eventual propagation of fuel pin failure, the temperature as a function of the time, sodium-canning-fuel interactions, and fuel relocation. The capsule which was irradiated in the H.F.R. poolside facility consisted of a single fuel pin surrounded by stagnant sodium. The generated heat was transported in radial direction via a NaK-filled annulus surrounding the sodium containment. Expulsion and replacement of the NaK by a driving gas (helium) restricted the heat removal by about 70%. The sodium temperature increased rapidly until boiling started, followed by canning failure and fuel melting. Nine transients have been performed with fresh fuel pins of which some were pre-pressurized. Pre-irradiation of capsules before performance of the transient is in progress. The capsule offers the possibility to study transient behavior for fuel pins with a pin diameter of seven millimeters and an active fuel length of 25 centimeters. (auth)

24947 (SAND-75-6003) PULVERIZATION OF A MELTED MATERIAL BY CONTACT WITH A REFRIGERANT LIQUID. Semeria, R.; Mathieu, J. P.; Gouzy, A. Jan 1968. Translation of Report Note TT n 283. 50p. Dep. NTIS $5.50.

Examination of various accidents in pile or out of pile shows that these become explosive when the stored heat in the melted material is transmitted almost instantaneously to the coolant. This requires the rapid development of a contact area, that is to say a very fine pulverization resulting from a mechanical action of variable and often unexplained origin. Tests are summarized which attempted to reproduce a particular case of reaction: the expulsion of molten material from a fuel element through a small opening pierced in the cladding material in contact with liquid coolant. The tests dealing with melted tin, heated well above its melting point and contained in a stainless steel tube show that: (1) In the absence of any initial internal overpressure, the tin is violently expelled into the cold water surrounding the tube; (2) The metal particles after reaction are very fine (10–100 μ diameter); and (3) There is generation of an internal pressure just before the expulsion which is attributed to the introduction and vaporization of water in the tube. (auth)

24948 (TSCS-ATP-005) TSCS ACCEPTANCE TEST PROCEDURE FOR NERVA ENGINE. Rack 63 (Reactor Safety System-Engine Safety System). Issue 5. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Feb 1967. 38p. Dep. NTIS $5.00.

24949 OPERATIONAL LIMITS FOR GAS TURBINE COMPRESSORS DURING TRANSIENT CONDITIONS IN A HELIUM COOLED REACTOR. Tiberini, A. (Swiss Federal Inst. Wurenlingen, Switzerland). J. Eng. Power; 96: No. 4, 427-434 (Oct 1974).

The use of gas turbines in Gas Cooled Fast Reactors requires an accurate analysis of the loss of pressure accident induced by the rupture of a main helium pipe. A multiloop design is considered. The loop in which the pipe rupture occurs is assumed to be out of operation. The results presented show under which conditions the turbogroups of the nondamaged loops are capable to maintain forced convection, thus ensuring the after heat removal even if a very small quantity of coolant gas is left in the reactor system. In particular the influence of the flow restrictors at the reactor inlet and outlet, the total helium mass, the final containment pressure, the pony motors and the scram delay on the proper functioning of the helium compressors is investigated. 5 references. (auth)

24950 SAFETY AND SITING OF NUCLEAR POWER PLANTS. Greenhalgh, G. (British Nuclear Forum, London). Nucl. Eng. Int.; 19: No. 223, 1015-1021(Dec 1974).

The evaluations and conclusions are discussed of a report of a Swedish study into the urban siting of nuclear power stations for the purpose of using nuclear power for combined district heating and power production. In assessing the risks involved, figures are quoted for the probability of death or injury in Sweden from other types of hazards. In the evaluation of environmental risks resulting from reactor accidents the magnitude of the consequences of an accident is related to the probability of these consequences. Types of failure which could lead to a major accident are considered, and order of magnitude of the percentage of the core content of iodine and noble gases judged likely to be released to the environment are given in each case. A qualitative assessment is also made of the means by which the release could occur. The consequences of an accident are presented graphically for 4 sites at distances between 5 and 100 km from a city center. Alternative means of district heating are also investigated. It is concluded that in the metropolitan areas Sweden should use combined nuclear heat and power plants, but urban reactor sites should be avoided until further experience has been obtained. (UK)

24951 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 6. Nuclear Energy and the Public. Toronto; Canadian Nuclear Association (9 Jun 1974). vp. (In English and French). (CONF-740681-P6; 74-CNA-600).

Information on the public acceptance of nuclear power plants is presented. A separate abstract is included for one of the six papers presented. Four of the remaining papers have previously been evaluated for and included in NSA and can be found in the NSA Report Number Index under CONF-740681-P6 and 74-CNA-600. (DCC)

For an abstract of an individual paper see: 24952.

24952 PUBLIC ACCEPTANCE OF NUCLEAR POWER: A WORLDWIDE PROBLEM. Rippon, S. E. (Nuclear Engineering International, London). pp Paper 604, 9p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 6. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

International aspects of factors which determine public opposition to reactors or their acceptability and licensing are discussed. Topics mentioned include low-level radiation, thermal pollution, fault trees, and radioactive waste storage. The treatment is general or political rather than technical. (CA)

24953 ISSUES FACING NUCLEAR POWER. Warren, F. H. pp 83-87 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

An attempt is made to identify the primary issues which might significantly diminish the net benefits of nuclear power. (JWR)

24954 FLOW COAST DOWN AND THE CORRESPONDING SCRAM DELAYS AFTER SIMULATED FAILURE OF PUMP POWER SUPPLY IN EWA RESEARCH REACTOR. Strupczewski, A.; Budzinski, W.; Kicman, J. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 11, 21-30(1973).

Flow coast down and the corresponding scram delays in EWA research reactor were studied after simulated failure of power supply to one, two and three pumps in the primary circuit. The measurements were performed at reactor shutdown and aimed at establishing the real curve of flow coast down as well as the apparent curves of flow and pressure transients measured by EWA stationary equipment. Scram delays for studied cases were recorded. The case of the outage of one high voltage line with an automatic pump power supply switch over to another line was also studied. (auth)

24955 REFLECTIONS ON THE RUSMUSSEN REPORT AND ITS IMPLICATIONS FOR REACTOR DESIGN. Cave, L. (Pollution Prevention (Consultants) Ltd., Crawley, Eng.). Nucl. Eng. Int.; 19: No. 223, 1012-1014(Dec 1974).

A reactor safety study consisting of an assessment of accident risks in U. S. commercial nuclear power plants is discussed with some critical observations on the methods used and the results obtained. In addition, some interesting observations are made on the implications of the study for design philosophy for other types of reactors. (auth)

24956 RASMUSSEN STUDY ON REACTOR SAFETY. Rippon, S. Nucl. Eng. Int.; 19: No. 223, 1001-1011(Dec 1974).

A review is presented of the report (WASH-1400) of a study commissioned by the USAEC and carried out under Professor Rasmussen, on the "assessment of accident risks in U. S. commercial nuclear power plants." The study demonstrates that the prominence given to a large scale accident is out of all proportion to the actual risks involved. A brief indication is

given of the contents of the main report, the ten appendices, and the summary report. The realistic approach of the study, which was limited to PWRs and BWRs, is discussed and the assumptions and techniques used are examined in some detail. The results are briefly compared with those of an earlier study (WASH 750) which used a more conservative approach. (UK)

24957 EARTHQUAKES, PLANE CRASHES, AND EXPLOSIONS. A Report on the German IRS Specialist Meeting, Cologne, October 30-31, 1974. Nucl. Eng. Int.; 19: No. 223, 1021-1023(Dec 1974).

From IRS specialist meeting; Cologne, Ger. (30 Oct 1974).

A report is presented on the October 1974 German IRS Specialists Meeting in Cologne at which five papers were given which were devoted to the protection of nuclear plants from external influences such as earthquakes, fast flying aircraft crashing into reactor buildings, and ignition of explosive gas clouds around nuclear plants. The analytical procedures and experimental programs under way in many cases resemble the extensive work already done in the U. S. A. In many ways German licensing requirements are more severe than those in other countries. (auth)

24958 ELECTRICAL SUPPLY AND THE FUTURE. II. Siting of Power Stations. Carter, J. Architects' J.; 5: No. 161, 255-262(29 Jan 1975).

A discussion is presented on planning consents and stringent site requirements, how site requirements limit the choice of sites, and how nuclear power stations inhibit use of surrounding areas. The discussion covers the following topics: cooling water and remote siting, emergency plans (for reactor accidents), the search for sites, planning consents, nuclear site licensing, site area, site access, disposal of wastes, noise and pollution, amenity and protection, and the power station image. (UK)

24959 SURVEY OF DEFECTS IN PRESSURE VESSELS BUILT TO HIGH STANDARDS OF CONSTRUCTION AND ITS RELEVANCE TO NUCLEAR PRIMARY CIRCUITS. Smith, T. A. (United Kingdom Atomic Energy Authority, Risley, Eng.); Warwick, R. G. Int. J. Pressure Vessels Piping; 2: No. 4, 283-322(Oct 1974).

Reported failure data on pressurized vessels built to high standards of construction are surveyed. The period covered is from the latter half of 1967 until the end of 1972, the information under review being limited to that gathered by the Associated Offices Technical Committee and the UKAEA Safety and Reliability Directorate. All reported events are analyzed, categorized, and tabulated, and a survey of British and American nuclear power plant cooling circuits has been made for comparison with conventional plants of relevant construction and service. Failure probabilities for the various categories of plant considered are established. (UK)

24960 COMBINED STORAGE TANK AND SUMP FOR NUCLEAR REACTOR. Flynn, E. P.; Rogers, A. C. (to Combustion Engineering, Inc.). US Patent 3,859,166. 7 Jan 1975. Filed Date 1 Dec 1972. 10p.

A description is given of a combined coolant storage tank and sump located within the containment structure which surrounds and isolates the nuclear reactor. The combined tank and sump provides a means for storing a supply of emergency coolant for use in cooling the nuclear core of the reactor in the event of a loss of coolant accident in the primary coolant circulating loop and also provides a means for accumulating any coolant fluid discharged into the containment atmosphere. Conduit means are provided to flow couple the combined tank and sump and the nuclear reactor, and drive means are provided for driving the emergency coolant from the combined tank and sump into the nuclear reactor in the event of an emergency requiring injection of the coolant into the nuclear reactor. Also the combined tank and sump provides a means for relieving the pressure in the secondary side of the heat exchanger and in the pressurizer. (Official Gazette)

24961 DRAFT OF A SAFETY RELATED TECHNICAL REGULATORY GUIDE OF THE KTA. KTA 2201.1-Edition 9/1974. Layout of Nuclear Power Plants Against Seismic Influences. VGB Kraftwerkstechnik; 54: No. 10, 696-698(Oct 1974). (In German).

The purpose of the regulatory guide is to guarantee that a nuclear power plant will be of no greater danger to its surroundings in a seismic active region than a comparable nuclear power plant in a seismic non-active region. The regulatory guide is to be valid for the layout of all fixed nuclear power plants in the FRG. This first part deals with the fundamentals: layout and safety earthquakes, earthquake zones, seismophysical reference magnitudes, classification of the design parts, loads, seismic calculation, stresses and deformations, seismic instrumentation and effects of the safety earthquakes on the site. (GE)

24962 POWER STATIONS AND THEIR IMPACT ON THE ENVIRONMENT IN AREAS OF INDUSTRIAL CONCENTRATION. von Gersdorff, B.; Sommer, W. (Berliner Kraft- und Licht (BEWAG)-A.G. (F. R. Germany)). Brennst.-Waerme-Kraft; 26: No. 9, 393-397(Sep 1974). (In German).

Geographically, energy requirements are distributed very unevenly. In the local range, problems result from heat surplus and air pollution. The combination of power and heat generation reduces these influences. The example of West Berlin is used to show heat and electricity demands of a large city, limits of combined generation in heating and power stations, problems of designing district heating supply plants, as well as to discuss influences of power and heating combination on air pollution and waste heat loading. The connection of gas turbines with the electrical and heating side of conventional and nuclear steam power plants appears interesting for the future. (auth)

24963 RECOMMENDATIONS OF THE REACTOR SAFETY COMMISSION, PRESENTED AT ITS 94TH MEETING ON MAY 22, 1974. IRS Kurz-Inform., Reihe C; No. 17, 1-5(1974). (In German).

The following statements are dealt with: (1) The Reactor Safety Commission approves of the commissioning of the Biblis-A nuclear power plant. (2) The blowdown program for the pressure suppression system of the KKB is accepted. (3) The so-called immersion cooling system, designed as a redundant system, of the SNR-300 is capable of removing the afterheat in case of incidents caused by external impacts, if this is no longer guaranteed by the three main cooling systems. (4) The rules for the dimensioning of reinforced concrete component parts subject to extraordinary external stresses, set up by the Institute for Structural Engineering, are considered to be very useful. (5) Statement concerning projected control systems. (GE)

24964 10 JAHRE LABORATORIUM FUER REAKTOR-REGELUNG UND ANLAGENSICHERUNG. (Laboratory for Reactor Control and Plant Safety Now Ten Years Old). Muenchen, F. R. Germany; LRA (Jan 1974). 118p.

Issued on the occasion of the tenth anniversary of the foundation of the Laboratory for Reactor Control and Plant Safety (LRA), this booklet describes the activities of the LRA and tries to present a more general survey of the results achieved so far. The main topics discussed cover the fields of reactor statics and dynamics, process techniques and thermohydraulics, systems analysis and process control, and finally data acquisition and processing. (GE)

24965 HIGH RELIABILITY IN THE ELECTRONICS OF SAFETY SHUTDOWN CIRCUITS. Schultz, M. A. (Pennsylvania State Univ., University Park); Guild, R. D.; Chipps, J. D. Nucl. Technol.; 25: No. 3, 464-470(Mar 1975).

The use of complex, multiplexed, integrated circuits is proposed for the electronics of nuclear safety shutdown systems. The reliability of such circuit configurations for random failures is favorably compared with paralleled path electronics and is indicated to be extremely high. Advantages in common-mode failure reductions are suggested, and the overall reliability of such circuits without maintenance is indicated to be as high as present-day circuits with maintenance. (auth)

24966 POST-SHUTDOWN FISSION-PRODUCT DECAY HEATING FOR PLUTONIUM-239-FUELED FAST REACTORS. Sporrer, R.; Christenson, J. M. (Univ. of Cincinnati). Nucl. Technol.; 25: No. 3, 440-449(Mar 1975).

Fission-product decay heat rates in shutdown ^{239}Pu-fueled fast reactors are determined by direct calculation using a modified version of the CINDER code with a fission-product library of 344 nuclides. Systematic variations in fluence, flux level, irradiation time, and the initial ^{238}U/^{239}Pu ratio are made for the ranges of current interest, and their effects on the decay heat rate for the first ten years after reactor shutdown are investigated. Variations in irradiation history and the ^{238}U/^{239}Pu ratio over the ranges considered cause the total decay heat rate to vary by <18% during the first day after shutdown. (auth)

24967 HEAT LOSS TO COLD STRUCTURE DURING AN LMFBR HYPOTHETICAL CORE-DISRUPTIVE ACCIDENT. Chen, W. L. (Argonne National Lab., IL). Nucl. Technol.; 25: No. 3, 471-476(Mar 1975).

A simple method has been developed for calculation of transient heat losses that occur as a hot fluid produced during a liquid-metal fast breeder reactor hypothetical core-disruptive accident expands through the fission-gas plenum region. The heat-conduction equation of the plenum cladding is formally solved by the Laplace transform for a time-dependent cladding surface temperature, and the resulting solution is numerically evaluated using an integration method based on the trapezoidal rule. The

expanding hot fluid may be a two-phase mixture of sodium produced by a fuel-coolant interaction or a two-phase mixture of fuel produced by a severe nuclear excursion. Illustrative calculations have been performed considering a hypothetical fuel-coolant interaction in the Fast Flux Test Facility core. (auth)

24968 BURNOUT IN BOILING HEAT TRANSFER. I. Pool-Boiling Systems. Bergles, A. E. (Iowa State Univ., Ames). Nucl. Safety; 16: No. 1, 29-42(1975).

Recent experimental and analytical developments in pool-boiling burnout are reviewed, and results are summarized that clarify the dependence of critical heat flux on heater geometry and fluid properties. New analytical interpretations of burnout are discussed, and the effects of surface condition, aging, acceleration, and transient heating (or cooling) are described. Augmentation of critical heat flux, the relation of sound to burnout, and new techniques for stabilizing electric heaters at burnout are also considered. 86 references. (auth)

24969 INCIDENT AT THE LUCENS REACTOR. Miller, J. M. Nucl. Safety; 16: No. 1, 76-79(1975).

The Lucens 8.3-MW(e) experimental nuclear power station suffered a loss of CO_2 coolant and D_2O moderator, as well as damage to one of its fuel elements, on Jan. 21, 1969. Some of the preliminary results of the investigation as to the cause of the incident are presented. The final results have not been published. (auth)

24970 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Castro, W. R. Nucl. Safety; 16: No. 1, 87-97(1975).

The information on reactor occurrences comes from reports that were abstracted for the Nuclear Safety Information Center at Oak Ridge National Laboratory in September and October 1974. A brief description of each incident is included in the tabulated data, along with the reactor and facility (or institution) at which the incident occurred. (auth)

24971 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN SEPTEMBER AND OCTOBER 1974. Castro, W. R. Nucl. Safety; 16: No. 1, 101-103(1975).

Incidents discussed include: damage to the Dresden 3 feedwater system; demineralizer resin in the reactor vessel at Arnold 1; cracks in recirculation loop at Dresden 2; failure of the HPCI system to start at Quad Cities 2; and recurring leaks into the main condenser at Dresden 2. (auth)

Reactor Theory and Calculation

24972 (COO-2280-10) ISOPERIMETRIC INEQUALITIES FOR A CRITICAL REACTOR. Payne, L. E.; Stakgold, I. (Northwestern Univ., Evanston, Ill. (USA). Technological Inst.). Jun 1974. Contract AT(11-1)-2280. 17p. Dep. NTIS $4.00.

Various bounds relating to the fundamental eigenfunction of the Helmholtz equation are obtained. This eigenfunction represents the neutron density in a homogeneous, monoenergetic, critical reactor. Isoperimetric inequalities are obtained for the average-to-peak eigenfunction ratio. (JWR)

24973 (IKE-4-33) AN AUTOMATIC DISCRETISATION FOR TWO SPECIAL NUMERICAL METHODS FOR SOLVING THE BURNUP EQUATIONS. Neubauer, W. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Sep 1974. 44p. (In German). INIS.

An automatic discretisation method for both burnup codes IKEV and ANALYT is described which fixes the time intervals so that the isotope densities are present with the desired accuracy at the end of the calculation interval. (GE)

24974 (INIS-mf-1383, pp 22-28) ANALYTICAL SOLUTION OF THE CARLSON S_n-EQUATIONS FOR SPHERICAL GEOMETRY. Davydov, V. I.; Shikhov, S. B. 1973. (In Russian).

The calculation of a multizone spherical reactor is described for the case of S_n approximation by the analytical iterationless method. The one-velocity gas kinetic Boltzmann equation is transformed by the Carlson S_n method. The system of linear homogeneous differential equations obtained are solved by using the method of the matrix contraction of the zone where the solution is synthesized in the form of a finite power series on the basis of a precise analytical representation. (tr-INIS)

24975 (INIS-mf-1383, pp 28-34) SPECTRAL THEOREM IN THE THERMALIZATION THEORY. Shikhov, S. B.; Shishkov, L. K. 1973. (In Russian).

The linear neutron transport equation is examined. The spectral theorem in the thermalization theory is proved. (tr-auth)

24976 (INIS-mf-1383, pp 34-38) ITERATIVE SYNTHESIS ALGORITHM FOR THE NONSTATIONARY MULTIGROUP DIFFUSION EQUATION SOLUTION. Slesarev, I. S. 1973. (In Russian).

An algorithm is proposed for the solution of the non-stationary problem by means of the variational synthesis method, constructed on the basis of iteration schemes for the mutual correction of test functions. (tr-auth)

24977 (INIS-mf-1383, pp 38-41) NEUTRON DISTRIBUTION PROFILES IN THE TRANSITION REGION OF A SUBCRITICAL SYSTEM. Lomidze, V. L.; Naumov, V. I. 1973. (In Russian).

The different methods for profiling the neutron distribution in the transition region during experiments on a subcritical assembly are examined. The problem of the optimum arrangement of fissionable and scattering materials used for profiling neutron distributions is solved. (tr-INIS)

24978 (INIS-mf-1383, pp 52-56) CALCULATION OF HETEROGENEOUS SYSTEMS WITH VARIATIONAL SYNTHESIS ALGORITHMS. Sirotkin, A. M.; Slesarev, I. S.; Khromov, V. V. 1973. (In Russian).

An algorithm is developed for the calculation of the heterogeneous effect of a critical assembly. It uses the variational subgroup method. An evaluation is made of the efficiency of the method proposed. (tr-auth)

24979 (INIS-mf-1383, pp 56-64) VARIATION-ITERATION METHOD FOR CONDITIONAL SEPARATION OF VARIABLES IN A MULTIGROUP PROBLEM. Morozov, A. G.; Khromov, V. V. 1973. (In Russian).

An examination is made of the variation approach during formulation of equations for functions with separate variable multigroup reactor equations. The advantage of the variation formulation involves the possibility of obtaining conformable algorithms for calculation of the neutron flux and importance which is very important during the development of formulas of the small perturbation theory for effective multiplication constant. The multigroup equations of multizone one-dimensional reactors are examined in the diffusion approximation. Results are reported for the calculation of one-dimensional two-zone reactors in the four-group diffusion approximation. The calculations are made on a computer in order to confirm the analytical method proposed. The results show the validity of the method and the rapid convergence of the iteration process. (tr-INIS)

24980 (INIS-mf-1383, pp 64-70) SOME PROBLEMS IN APPLYING THE VARIATIONAL METHODS TO THE IMPROVEMENT OF CONVERGENCE OF ITERATIVE ALGORITHMS. Slesarev, I. S.; Sirotkin, A. M. 1973. (In Russian).

Some questions on the use of variational methods for improvement of the convergence of iteration processes are examined. The examination is made on an example of the problem connected with finding eigenfunctions and eigenvalues of some transfer operators. The results obtained in the verification of the proposed method for increasing the speed of the calculation of fields in multizone spherical reactors are reported. (tr-INIS)

24981 (INIS-mf-1383, pp 71-75) CALCULATION OF THE EFFICIENCY OF ESTIMATING THE HIGHER ORDER CORRECTIONS TO THE FLUX AND THE REACTIVITY OF A NUCLEAR REACTOR WITH EIGENFUNCTIONS. Kashutin, A. A.; Khromov, V.V. 1973. (In Russian).

Attempts to simplify the method of gradient descent (iteration processes making it possible to transfer from non-optimum variants to optimum variant because of the finite number of iteration cycles), used for the optimization of some reactor characteristics, are reported. A method of calculating the efficiency of the determination of higher order corrections to the neutron flux and of the reactivity by the eigenfunction method, which permits the exclusion of the direct calculation of the value and functionals and their first-order efficiency in each iteration, is examined. Numerical examples are given of calculations with the method proposed. (tr-INIS)

24982 (INIS-mf-1383, pp 75-82) ESTIMATIONS OF LARGE PERTURBATIONS OF NEUTRON FLUX AND REACTIVITY IN A NUCLEAR REACTOR WITH AN EIGENFUNCTION METHOD. Kashutin, A. A.; Khromov, V. V. 1973. (In Russian).

The possibility of applying the eigenfuction method to the calculation of the flux and reactivity in the one-group diffusion approximation for reactors with complex geometry is examined. In the calculations the neutron flux is divided into series according to the eigenfunctions of one-zone homogeneous reactors. A recurrence formula is obtained for the calculation of the expansion coefficient according to the eigenfunctions. Results of the study of the accuracy of the calculations by the method described as a function of the number of eigenfunctions are reported. An evaluation is made of the accuracy of the calculations by the method. (tr-auth)

24983 (IRS-T-21, pp 58-74) COMPARATIVE CONSIDERATIONS OF CALCULATIONS WITH THE PROGRAM SYSTEM TESTRAN AND ANALYTICAL SOLUTIONS FOR TENSION AND TEMPERATURE CALCULATIONS. Kroiss, G. Mar 1974. (In German).

From VdTUeV/IRS—colloquium; Koeln, F. R. Germany (20 Mar 1973).

In finite-element method in the evaluation of structural components.

The finite element program TESTRAN developed at the Technical University, Trondheim, is described. The program permits the calculation of stationary and nonstationary temperature fields with the same idealization with which the tensions are determined. The limitations of the relatively small program system are due to the limited number of nodal points and to the applicability exclusively to plane and rotation symmetrical problems. (GE)

24984 (IRS-T-21, pp 104-112) POSSIBLE ERRORS IN USING FINITE ELEMENT METHODS. Hofmann, H. H. Mar 1974. (In German).

From VdTUeV/IRS—colloquium; Koeln, F. R. Germany (20 Mar 1973).

In finite-element method in the evaluation of structural components.

Possible errors (rounding off, discretisation) occurring in the application of finite element methods are discussed. (GE)

24985 (KFK-2075) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE INFLUENCE OF FEEDBACK EFFECTS FOR THE POINT AND TWO-POINT REACTOR MODEL. Vaeth, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1974. 81p. (In German). Dep. NTIS (US Sales Only) $7.00.

Thesis. Submitted to Karlsruhe Univ., West Germany.

The neutron power spectral density of power reactors is influenced by many parameters. These can be summarized into two groups. The first being reactivity perturbations whose statistical characteristics are unknown in most cases, and the second being various feedback and spatially dependent transfer functions. In the case of all effects being simultaneously present, which is the case for power reactors, it is extremely difficult to understand the spectra in detail. However some of the reactivity perturbations and their influence on the neutron noise in large power reactors can be simulated in a zero power reactor. In this way the effects can be studied more flexibly without the interference of other effects. Investigations of the influence of a known feedback—namely a control loop with known transfer function—on the spectra of neutron chamber signals are described. Theoretical formulas for the spectra are derived using the point reactor model. These formulas were verified by noise measurements in a zero power reactor. In addition special attention is given to the noise generated by the control loop. The influence of this feedback noise on the spectra is verified experimentally. In large reactors space dependent transfer functions must be taken into account. As a first approximation to handle the spatial dependence, the investigations were extended to the two-point reactor model. Corresponding experimental work was done for the Argonaut Reactor Karlsruhe (ARK) with a symmetrical two-slab core loading. As an application to a more realistic situation coolant boiling in a BWR has been investigated. The boiling must be considered as a feedback mechanism as well as an external reactivity perturbation. In order to simulate the steam bubble content, nitrogen gas was injected into the water moderator of the ARK. By modulating the total gas flow rate according to the momentary reactor power the feedback effect was simulated. The gas flow produced a band limited white reactivity noise. The upper break frequency could be used to determine the travelling time of the bubbles through the core. (auth)

24986 (KFKI-74-72) SUBCRITICALITY MEASUREMENTS IN A HEAVILY REFLECTED REACTOR. Valko, J.; Por, G. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1974. 38p. Dep. NTIS (US Sales Only) $5.00.

The applicability of the original area-ratio method of Sjöstrand to measure reactivity at relatively deep subcriticalities is analyzed. The basic theoretical results concerning the formulation of validity criteria of the method and specifically the role of the reflector are discussed. The critical system and the experimental apparatus are described and the experimental results are given. The experiments reported here were performed primarily for comparison with theoretical predictions and numerical results. This is the comparison of certain tendencies like the behavior of Sjöstrand and Gozani reactivities as functions of reflector thickness, target position, and subcriticality. 19 references. (auth)

24987 (SRARI-P-216) SOLUTION OF THE TWO-DIMENSIONAL RADIAL TEMPERATURE FIELD PROBLEM IN A CYLINDRICAL FUEL ELEMENT BY THE POTENTIAL THEORY METHOD. Kormushkin, Yu. P.; Okhrimenko, A. I.; Polivanov, I. F. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The method described is based on the classical potential theory as applied to the solution of the problem on the radial temperature distribution in a cylindrical fuel element. A set of convenient formulae have been obtained being of practical significance. It is shown that an integral formulation of the problem on temperature distribution contains much more potentialities for investigating more complicated problems as compared to the boundary value problem in differential form. (auth)

24988 THERMAL NEUTRON SPECTRA NEAR CADMIUM PLATE IN WATER MODERATOR. Hussein, A. Z.; Eid, Y.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Reactor and Neutron Physics). Atomkernenergie; 24: No. 2, 99-102(1974).

6 figs.; 1 tab.; 17 refs.

A time-of-flight neutron spectroscopy measurement has been performed in an infinite water moderator in the vicinity of an infinite cadmium plate of 1 mm thickness. Measurements of the spatial behavior of the neutron spectra were carried out in the vectorial directions, $\mu = +1$, $\mu = -1$, at various symmetrical distances from the plate surface. Also the grazing spectrum ($\mu = 0$) was measured at 0.65 cm from the cadmium surface. A flat exit tube has been used to extract neutrons at the points of measurements in the assembly. Distortions caused by the exit tube along with other required corrections were introduced to the measured spectra. Satisfactory agreement was found between measurements and the available calculations based on the Nelkin model for water. (auth)

24989 DISCRETE INTEGRAL TRANSPORT THEORY EXTENDED TO THE CASE WITH SURFACE SOURCES. Jonsson, A.; Goldstein, R.; Mockel, A. (Combustion Engineering, Inc., Windsor, Conn. (USA). Nuclear Power Systems Div.). Atomkernenergie; 24: No. 2, 79-84(1974).

4 figs.; 1 tab.; 8 refs.

The discretized form of integral transport theory is extended to finite geometry, where neutrons with arbitrary angular and spatial distributions may be incident on the surface of each finite volume. For a lattice, therefore, the equations not only contain volume sources, but also involve relations between the entering and exiting currents for each cell. Solutions are carried out in general cylindrical geometry and then specialized to the case of symmetric cells with isotropic scattering. Numerical solutions are given in terms of tabulated functions. Reciprocity and conservation theorems are derived in moment form for the general case of arbitrary angular and spatial distributions. (auth)

24990 RANDOM PROCESSES IN NUCLEAR REACTORS. Williams, M. M. R. Oxford; Pergamon Press (1974). 256p.

The subject is dealt with in chapters entitled: historical survey and general discussion; introductory mathematical treatment; applications of the general theory; practical applications of the probability distribution; the Langevin technique; point model power reactor noise; the spatial variation of reactor noise; random phenomena in heterogeneous reactor systems; and associated fluctuation problems. (UK)

24991 DYNAMICS OF AQUEOUS HOMOGENEOUS PULSE REACTORS. Sizov, A. N.; Kolesov, V. F. Sov. J. At. Energy (Engl. Transl.); 35: No. 3, 827-828(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 185(Sep 1973). This is a summary of paper No. 683/7180 with full copy held at TIC.

A derivation of a system of equations describing the dynamics of aqueous homogeneous pulse reactors is given. The system comprises equations for radiolytic gassing and neutron kinetics. (auth)

24992 FUELS AND MATERIALS FAST-REACTOR DOSIMETRY DATA DEVELOPMENT AND TESTING. McElroy, W. N.; Kellogg, L. S. (Hanford Engineering Development Lab., Richland, WA). Nucl. Technol.; 25: No. 2, 180-223(Feb 1975).

The development, design, and operation of nuclear reactors require the accurate prediction of (a) fission rates and burnup for fuels and (b) neutron exposure for neutron-induced property changes for fuels and materials. Goal accuracies of as low as 1% (1σ) have been set for the determination of fission rates, burnup, and neutron fluences for the fast-reactor development program. Based on the discussion of the status of fuels and materials fast-reactor dosimetry data development and testing,

attainable goal accuracies presently appear to be in the range of 2 to 5%. Significant progress has been made in achieving high-accuracy measurements through a coordinated interlaboratory effort of integral measurements in low- and high-intensity neutron fields. A few of the major accomplishments of this interlaboratory work are described. Comparisons are made of CFRMF and ΣΣ results with those reported previously for GODIVA and the ^{235}U fission spectrum. Fission yield results are considered, based on measurements in the high-intensity environment of EBR-II. These results are coupled with those from CFRMF, ΣΣ, and other neutron fields to more clearly define and document existing uncertainties associated with reaction-rate, fuel burnup, and flux-spectral-fluence determinations in fast reactors. (73 references) (auth)

24993 GAMMA NOISE MEASUREMENTS AT A FAST REACTOR. Baers, B.; Hernberg, R. (Technical Research Center of Finland, Helsinki). Kernenergie; 17: No. 11, 357-358(Nov 1974).

It is experimentally confirmed that the relaxation effects associated with the spontaneous fluctuations in the neutron population, and in the γ-ray emission, at a fast subcritical reactor are observable by the agency of ex-core gamma noise measurements. 8 references. (auth)

24994 OPTIMAL REACTOR CONFIGURATION YIELDING MAXIMUM POWER I. Bartosek, V.; Zalesky, K. (Nuclear Research Inst., Rez, Czechoslovakia). Kernenergie; 17: No. 11, 351-356(Nov 1974).

Using Pontryagin's maximum principle, the problem of optimal space distribution of control (which may be e.g., fuel concentration, enrichment, or irradiation) yielding maximum power in a slab reactor is solved. The one-group diffusion model is used and it is supposed that both the material buckling and the effective fission cross section depend linearly on the control. Constraints on the maximum and minimum allowable values of control as well as on the maximum allowable flux and power density, respectively, are considered. The rigorous optimal reactor core configuration is a priori found for all permissible core thicknesses as well as for any reflector thickness. 9 references. (auth)

24995 CHECK OF THE ACCURACY OF THE HEAT-RESISTANCE APPROXIMATION IN UO_2 FUEL ROD DYNAMIC BEHAVIOUR. Fiebig, R. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany). Inst. fuer Physik). Atomkernenergie; 24: No. 2, 105-110(1974). (In German).

The heat resistance approximation used for description of a fuel rod in a water reactor core is checked by calculations with the program TOODEE. It is shown that use of a quasistationary approximation is sufficient for time dependent realistic reactor excursions. But non-linearities in heat capacity and heat conductivity of UO_2 cannot be neglected if accuracy less than 10% is attempted. (auth)

24996 ISOTROPIC BOUNDARY CONDITION IN CYLINDER LATTICE WITH FINITE HEIGHT. Fukai, Y. (Nippon Atomic Industry Group Co. Ltd., Kawasaki, Kanagawa. Nuclear Research Lab.). Atomkernenergie; 24: No. 2, 85-87(1974).

Although it is well known that the isotropic boundary condition is applicable to a cylindricalized lattice with infinite height, the inadequacy of the condition to lattices with finite height is presented here. This is numerically shown for many two-region lattices, each region of which has the same cross sections and the same strength of neutron source. Finally a correction method is suggested, considering the anisotropy of reflected neutrons at the cylindricalized cell boundary to the axial direction. (auth)

24997 DISCRETE MONITORING AND OPTIMIZATION OF POWER DISTRIBUTION IN REACTOR CORES. Emelyanov, I. Ya.; Drozdov, A. V.; Konstantinov, L. V.; Nazaryan, V. G.; Postnikov, V. V. At. Energ. (USSR); 37: No. 6, 451-454(Dec 1974). (In Russian).

A generalized model of discrete monitoring, taking into account type of registered radiation and spatial energy resolution of detectors, is presented. The application of linear programming methods for statistical optimization of power distribution in a nuclear reactor based on in-core detector readings is considered. (3 references) (auth)

24998 SIMPLE METHOD OF NUCLEAR REACTOR KINETICS EQUATIONS NUMERICAL INTEGRATION WHEN AN EXTERNAL SOURCE IS BEING USED. Sapozhnikov, V. V.; Krylov, E. V. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 13-15(1973). (In Russian).

This study presents a method of numerically integrating the kinetic equations of a nuclear reactor with an external source, which is based on approximating the exponent with a matrix index-product of five matrices. It is shown that at an integration step of 10^{-3} sec an accuracy of better than one percent can be obtained. (tr-auth)

Reactor Components and Accessories

Refer also to abstracts 22168, 22384, 22388, 22536, 22538, 23353, 24673, 25041, and 25095.

24999 (COO-3049-5) SEMIANNUAL PROGRESS REPORT, MARCH 1, 1974–AUGUST 31, 1974. First, M. W.; Goldin, A. S.; Underhill, D. W.; Ayers, J. W.; Moeller, D. W. (Harvard Univ., Boston, Mass. (USA). Harvard Air Cleaning Lab.). Dec 1974. Contract AT(11-1)-3049. 103p. Dep. NTIS $8.25.

Separate abstracts are included for each of the 5 papers presented concerning air cleaning systems for nuclear facilities. (DCC)

For abstracts of individual papers see: 22151, 22589, 24657, 25000, and 25001.

25000 (COO-3049-5, pp 1-12) BEHAVIOR OF FISSION GAS HOLDUP BEDS DURING NORMAL STARTUP, ACCIDENTAL LOSS OF REFRIGERATION, AND SPILLAGE OF CHARCOAL. Underhill, D. W. Dec 1974.

In semiannual progress report, March 1, 1974–August 31, 1974.

Charcoal adsorption beds are an important adjunct in reducing the exposure of the public to fission produced noble gases. These beds serve to retain fission gases even after conditions such as spillage of the charcoal. Calculations of fission gas releases under conditions other than simple steady state operation are presented. (auth)

25001 (COO-3049-5, pp 13-31) PERFORMANCE OF AIR CLEANING SYSTEMS IN NUCLEAR FACILITIES. Moeller, D. W. Dec 1974.

In semiannual progress report, March 1, 1974–August 31, 1974.

A review of published reports of failures in air cleaning and airborne waste management systems at nuclear installations over the past several years indicates instances of disruption of noble gas adsorption systems due to hydrogen explosions, decreased performance of particulate filters due to the presence of contaminants or the failure of seals and damper controls, and improper evaluation of the efficiency of air cleaning systems due to sampling and other procedural errors. A tabulation of the major abnormal events reported to have occurred in air cleaning systems since 1966 and an assessment of these events in terms of their implications to air cleaning specialists are presented. Although a small portion of the reported failures can be attributed to manufacturing and design defects, a major share appear to be due to errors on the part of the people responsible for the operation and maintenance of this equipment. (12 references) (auth)

25002 (IRS-T-21, pp 113-125) APPLICATION OF THE FEM TO THE STRENGTH ANALYSIS OF NUCLEAR POWER PLANT COMPONENTS. Waldner, K. Mar 1974. (In German).

From VdTUeV/IRS–colloquium; Koeln, F. R. Germany (20 Mar 1973).

In finite-element method in the evaluation of structural components.

The stress calculations of the components of the primary circuit and the containment are presented. The geometries and stresses as well as the calculation methods and their fields of application are described. The static calculation of the torus floor region of the condensation chamber with reinforced construction of the nuclear power plant Wuergassen for a special stress condition is explained in an example. The calculation was carried out using the FEM (Finite Element Method). (GE)

25003 (IRS-T-21, pp 126-133) TEMPERATURE AND STRESS DISTRIBUTION IN THE ANNEALING OF WELDED JOINTS OF REACTOR PRESSURE VESSELS. Dost, L.; Eggers, H. Mar 1974. (In German).

From VdTUeV/IRS–colloquium; Koeln, F. R. Germany (20 Mar 1973).

In finite-element method in the evaluation of structural components.

Due to the transport problems involved, large reactor pressure vessels cannot always be completed in the works of the manufacturer. Thus the manufactured transportable parts of the pressure vessel have to be assembled on site by means of welded seams which have to be annealed afterwards in order to reduce residual stresses. (GE)

25004 QUASI-STATIC THERMAL STRESSES IN AN INFINITE SLAB DUE TO AXISYMMETRIC HEAT GENERATION. Goshima, T.; Koizumi, T.; Nakahara, I. (Tokyo Inst. of Tech. (Japan). Faculty of Engineering). Nucl. Eng. Des.; 31: No. 1, 77-86(Nov 1974).

By the parametric uses of a thermoelastic potential and a stress function, the thermoelastic problem is analyzed for the thermal stresses arising in an infinite slab from step-functional and axisymmetric internal heat generation. When the heat generation decays exponentially along the slab thickness such as in γ-ray and laser radiation and is uniform on a circular plane in a heated region, numerical calculations of the temperature and the thermal stress distributions are carried out. The influence of a decaying parameter and the Biot number on the results is analyzed. (auth)

25005 THE INTERACTION OF RATE AND HISTORY-DEPENDENT EFFECTS AND ITS SIGNIFICANCE FOR SLOW CYCLIC INELASTIC ANALYSIS AT ELEVATED TEMPERATURE. Krempl, E. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). Nucl. Eng. Des.; 29: No. 1, 125-134(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Life prediction for creep and low-cycle fatigue interaction and the analysis of ratcheting phenomena are of great importance in the design of future high-temperature nuclear reactors. These problems involve slow cyclic load application, inelastic deformation, and are inherently nonlinear. Fortunately, finite element computer programs with their time following and nonlinear capabilities are now available for the efficient solution of these complicated problems. The task is now to ensure that a proper representation of the material deformation behavior, the constitutive equation, is used in these computer programs. A systematic study of structural metal deformation behavior in slow cyclic laboratory tests such as cyclic creep, cyclic relaxation, low-cycle fatigue with and without hold-time showed that rate and history dependence interact. A few examples of such interactions are given. It is further shown that constitutive equations based on the additive use of elastic, plastic, and creep strains are not capable of reproducing these interaction phenomena on principal grounds. New inelastic constitutive equations for metals must be developed and some presently pursued approaches are discussed briefly. (auth)

25006 SEISMIC ANALYSIS OF CRACKED REACTOR VESSELS. Ariman, T. (Notre Dame Univ., Ind. (USA)); Hegarty, R. F. (Department of Engineering Science, Rockhurst College, Kansas City, Missouri, USA). Nucl. Eng. Des.; 29: No. 1, 89-109(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The dynamic response of a thin finite, elastic circular cylindrical shell representing a reactor vessel to time-dependent loadings symmetrical with respect to the axis of the cylinder is analyzed. The shell contains an axial through-crack of length 2c. The dynamic counterpart of Donnell's shell equations are used in this investigation. Extensive numerical results are presented for stress intensity factors in aluminum and steel vessels and results are discussed. (auth)

25007 NONLINEAR DYNAMIC ANALYSIS OF REINFORCED CONCRETE STRUCTURES. Stangenberg, F. (Bochum Univ. (F. R. Germany). Abt. fuer Maschinenbau und Konstruktiven Ingenieurbau). Nucl. Eng. Des.; 29: No. 1, 71-88(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Dynamic ultimate load calculations mainly for reinforced concrete beams and plates are discussed. Starting from the corresponding differential equations, the calculations also include the rotational inertia of single beam or plate elements as well as the shear deformations. With actual structural dynamic problems in nuclear power plants, the shear behavior of reinforced concrete beams and plates is more important than it is usually, as is shown by examples. The finite propagation velocity of bending and shear waves are taken into account. Solution of the equations of motion is obtained by numerical integration using finite time and space intervals. The calculations are performed using time dependent bending and shear laws for reinforced concrete up to the point of failure with realistic deformations. (auth)

25008 WATERSIDE FLOW PROBLEMS IN BOILERS. Firman, E. C. (Central Electricity Research Labs., Leatherhead, Eng.). CEGB Research; No. 1, 13-19(Dec 1974).

Modern boilers operate with heat fluxes much closer to the permissible limits so that it becomes increasingly important to understand the complexities of heat transfer and fluid flow within them and to appreciate the mechanisms of corrosion and possible failure. Research is in progress in a number of CEGB laboratories on various aspects of the behavior of steam-generating plants. At pressures up to 180 atmospheres and temperatures around 360°C, internal conditions typically approach the critical point at which water and steam phases become indistinguishable, but they normally remain sufficiently below criticality to give rise to many of the two-phase flow phenomena observable at less extreme temperatures and pressures. An attempt is made to give a broad picture of the practical problems associated with steam and water flows and of the methods being used to study them. An introduction is presented to a field which is important in relation to both nuclear-fueled steam generators and to conventional plants. (auth)

25009 CIRCUMFERENTIAL PRESTRESSING LOAD ANALYSIS DUE TO WIRE/STRAND WINDING SYSTEMS ON PRESTRESSED CONCRETE REACTOR VESSELS. Bangash, Y. (Thames Polytechnic, London). Proc. Inst. Civil Eng. (London); 57: 437-450(Sep 1974).

A theoretical investigation concerning the circumferential loads exerted on the outside face of prestressed concrete reactor vessels by wire/strand winding systems is reported. Two independent methods, the contact forces and spring stiffness concept and the non-linear finite element technique are described for computing the loads and ultimate strength reduction in the bottom layers of the bands. Non-linear finite element analysis is taken further to develop yield zones of contact areas of wires or strands. A reinforcement design is given for a typical channel or trough using three-dimensional finite element analysis. (auth)

25010 INSTALLATION OF NUCLEAR REACTOR COMPONENTS IN A CONTAINMENT BUILDING USING A DERRICK CRANE. Gitlevich, A. D. Ekspress-Inform., Montazh Oborudovaniya; No. 6, 28-29(1973). (In Russian).

An advantage of using a derrick crane with a 540 ton load capacity and a radius of action of 6 to 15 m for engineering installations is realized in the fact that the basic equipment can be installed in any sequence. The time for construction and installation is shortened by several months. The crane was used to install the equipment of the 855 MW(e) pressurized-water reactor at the Crystal River nuclear power plant simultaneously with the reinforced concrete shielding. (tr-auth)

25011 WELDING PROCESSES IN THE FABRICATION OF POWER PLANTS. Forcinal, C. (Alsthom, Belfort, France). Soudage Tech. Connexes; 28: No. 7, 293-307(Jul 1974). (In French).

Various aspects of the application of welding in big factories are reviewed together with the adaptation of the main welding processes to the fabrication of rotating components for power plants. Utilization of manual arc, submerged arc, electroslag, and electron beam welding for manufacturing alternator frames, turbine driving wheels for nuclear generating sets, as well as turbines and alternators for hydro-electric generating sets is presented. (FR)

25012 TERMINAL DE-SUPERHEATING DEVICE FOR STEAM BY-PASS APPLIANCES. (to Societe des Condenseurs Delas). French Patent 2,180,178/D/. 11 Apr 1972. 8p. (In French).

A terminal de-superheating device for steam by-pass appliances is described. This device, comprising two enclosures mounted one inside the other and from which steam successively flows through appropriate apertures is characterized in that the space defined by these enclosures comprises at least one expansion chamber, followed by at least one spraying chamber followed, in turn, by at least one outlet chamber, these chambers being separated by steam pervious screens. The device according to the invention can be applied in particular to the steam by-pass appliances of nuclear plants. (FR)

25013 SOME ASPECTS OF THE SURFACE PROTECTION OF NUCLEAR PLANTS. Bayliss, D. A. (Central Electricity Generating Board, London); Walker, P. Energ. Nucl. (Milan); 22: No. 1, 27-40(Jan 1975).

From 2nd international congress on protective technologies; Milan, Italy (24 Oct 1974).

The special requirements of surface coatings for the nuclear power industry are described, three main types of coating being considered: (a) surface coatings for contaminated areas, (b) surface coatings for high radiation level areas, and (c) surface coatings of the metal-free type. Some examples are given of the development work which has been carried out within U. K. Government laboratories to establish the principles of paint formulation, as well as a review of the suitability of existing types of surface coatings for the protection of nuclear plants and laboratories. (auth)

25014 HEAT EXCHANGER. Beckmann, G.; Fritz, K.; Lippitsch, J. (to Waagner-Biro Aktiengesellschaft). US Patent 3,850,235. 26 Nov 1974. Priority date 3 Aug 1971, Austria. 8p.

A heat exchanger of the type adapted for use in generating steam in a nuclear power plant, and a method for manufacturing the same are described. A plurality of curved tubular walls are equidistantly arranged with respect to each other around a central axis with each of these walls having an inner concave side directed toward the axis and an outer convex side directed away from the axis and with each of the walls including an elongated tube having a hollow interior through which a heat-exchanging medium is adapted to flow. Each of the walls further includes a fin structure fixed to the tube thereof at least partially along the tube for forming a vibration-resistant, unitary tubular wall structure. The heat exchanger is manufactured by curving a plurality of finned tubes and welding the tubes to each other to form a tubular wall. (Official Gazette)

25015 NUCLEAR TURBINE STEAM BYPASS DUMP VALVE. Lewis, I. J.; McCloskey, T. H. (to Westinghouse Electric Corp.). US Patent 3,858,844. 7 Jan 1975. Filed Date 18 May 1973. 12p.

A description is given of a fast opening valve for a pressurized fluid line. The valve comprises a body member having an inlet port and an outlet port therein, and a main plug member movably disposed within said body member. An over-balance chamber is defined by the main plug member and the interior of the body member. The overbalance chamber communicates with a dump line through a draining orifice and also communicates with the inlet port when the valve is closed. A pilot plug blocks the draining orifice and isolates the overbalance chamber from the dump line when the valve is closed. The main plug is held in the closed position against the force of a spring bias by a pressurized piston-cylinder arrangement. With the pilot plug blocking the draining orifice, the pressurized fluid collecting in the overbalance chamber exerts a force which assists in holding the valve closed. The valve is opened by a predetermined signal which contemporaneously releases the pressure force holding the main valve plug. The predetermined signal also opens the draining orifice. With the holding force relieved and the pressurized fluid drained from the overbalance chamber, the spring bias impels the main plug to the open position. A hydraulic damper absorbs high impact energies associated with the opening valve. (Official Gazette)

25016 ECONOMICAL DESIGN OF NUCLEAR PIPING SYSTEMS. Robinson, P. E. Power Eng.; 79: No. 1, 40-42(Jan 1975).

25017 INSERVICE INSPECTION OF NUCLEAR POWER PLANTS. Olds, F. C. Power Eng.; 79: No. 1, 28-35(Jan 1975).

Inservice inspection requirements and procedures for nuclear power plants are reviewed. (DCC)

25018 THEORY AND DESIGN OF MODERN PRESSURE VESSELS. Second Edition. Harvey, J. F. New York; Van Nostrand Reinhold Company (1974). 448p. $19.95.

Chapters of the book on pressure vessel design discuss pressure vessel design philosophy, stresses in pressure vessels, stresses in flat plates, discontinuity stresses in pressure vessels, pressure vessel materials and their environment, design-construction features, and design-construction economics. (DCC)

25019 EVOLUTION OF NUCLEAR POWER PLANTS AND REACTOR CHEMISTRY. Ullmann, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 11, 337-345(Nov 1974). (In German).

Temperature and pressure parameters, coolant (heat transfer) medium, structural and can materials have to be derived from the main points of view of the evolution of nuclear reactors, as conversion rate, doubling time, burnup, technology of coolant loops, efficiency, and unit power. Status of evolution and the problems of reactor chemistry and material properties to be solved are briefly presented for gas-cooled and water-cooled thermal reactors, fast breeders cooled by sodium, helium, steam, or nitrogen tetroxide. The chemico-technological problems of future reactor projects, as molten-salt and suspension-type reactors, thermonuclear fusion reactors, and chemonuclear reactors, are discussed. 71 references. (auth)

25020 ON THE CHOICE OF COOLING PARAMETERS OF THE CONDENSERS FOR NUCLEAR POWER PLANTS WITH DISSOCIATING GASES. Mikhalevich, A. A.; Nesterenko, V. B.; Peslyak, V. I.; Sobolevskij, R. G. (AN Belorusskoj SSR, Minsk. Inst. Yadernoj Ehnergetiki). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk; No. 4, 42-48(1973). (In Russian).

This study investigates the effect of cooling water parameters on the costs of condensers and water supply systems for atomic energy reactors based on a dissociating cooling medium of N_2O_4. As a result of the calculations the presence of clearly expressed minima was found in the total capital costs from the number of cooling cycles and temperatures of the cooling water. As an example the study presents recommendations on the selection of optimal cooling parameters for an atomic energy power plant with a power of 1000 megawatts in the center of the European part of the USSR with the use of cooling towers or artificial reservoirs as cooling media. (tr-auth)

Reactor Fuels

Refer also to abstracts 22126, 22167, 23151, 23156, and 23157.

25021 (AAEC/E-324) EFFECT OF PRESSURE ON BURNOUT IN ANNULI AND A 19-ROD CLUSTER COOLED BY UPFLOW OF FREON-12. Ilic, V. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1974. 31p. Dep. NTIS (US Sales Only) $4.75.

Burnout tests were conducted in Freon-12 at four different inlet pressures for four uniformly heated annuli, and three different inlet pressures for a 19-rod cluster (the respective inlet to critical pressure ratios being 0.21, 0.26, 0.33, 0.40 and 0.26, 0.32, 0.41). For the rod cluster, the ratio of the heat flux on the outer rods to the heat flux on the inner rods was 1.6. All annulus test sections were internally heated except one whose outer tube (shroud) only was heated. Resistance heating using d.c. power was used. Results show that, in general, for a constant inlet subcooling, increasing inlet pressure caused a non-linear decrease of burnout heat flux for mass velocities up to 4 Mg $m^{-2}s^{-1}$. An apparent independence of burnout heat flux from inlet pressure was observed for the rod cluster at a very small value of mass velocity (50 kg $m^{-2}s^{-1}$). At a high mass velocity (4 Mg $m^{-2}s^{-1}$), the internally heated annulus had a significantly greater burnout heat flux than the corresponding externally heated one. The CISE burnout correlation, modified for the effect of inlet pressure, generally underpredicted the burnout heat flux by up to 40 per cent. (auth)

25022 (ANL-Trans-974) ROLE OF CESIUM IODIDE IN THE DEVELOPMENT OF REACTIONS AT THE INTERFACES OF THE FUEL ([UPu]O_2 TYPE) AND CLADDING (AUSTENITIC STAINLESS STEEL TYPE). Out-of-Pile Experiments. Calais, D.; Aubert, M.; Le Beuze, R.; Conte, M.; Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jan 1975. Translation of SM-190/24. (CONF-741030-5). 15p. Dep. NTIS $4.00.

From symposium on thermodynamics of nuclear materials; Vienna, Austria (21 Oct 1974).

Out-of-pile simulation experiments were performed in order to study the compatibility of the following systems under isothermal conditions and with a thermal gradient: steel/I_2, steel/Cs, steel/Cs + Cs_2O, steel/Cs + Cs(OH), steel/CsI, steel/$(UPu)O_{2\pm x}$, steel/I_2 + $(UPu)O_{2\pm x}$, steel/Cs + $(UPu)O_{2\pm x}$, steel CsI + $(UPu)O_{2\pm x}$, using metallographic techniques, x-ray diffraction and x-ray microprobe analysis, in order to obtain a better understanding of the development of interfacial fuel-cladding reactions in reactors. These experiments revealed a gas-phase transport phenomenon of the Van Arkel type, involving the stainless steel (low temperature), and the oxide $(UPu)O_{2\pm x}$ (high-temperature), by the intermediary of cesium iodide. This transport phenomenon, which essentially concerns the displacement of manganese, chromium and iron from the cold to the hot zones, is possible only in the presence of an oxygen source (particularly, the mixed oxide $(UPu)O_{2\pm x}$). In the presence of a mixed oxide $(UPu)O_{2\pm x}$, CsI reacts with stainless steel, forming manganese, chromium and iron iodides and cesium uranoplutonate $Cs_2(UPu)O_4$. The iodides MnI_2, CrI_2, FeI_2 decompose in the hot zones, giving rise to precipitation of Mn, Cr and Fe and liberating the iodine which is thus available to react again with the steel in the form of cesium iodide. This becomes manifest by a progressive dechroming of the steel with a decrease of its oxidation resistance, so that it can react directly with the mixed oxide $(UPu)O_{2\pm x}$. In thin films removed from fuel elements of RAPSODIE-type fast reactors (steel 316 cladding, oxide fuel $(UPu)O_2$), the presence of iron- and chromium-rich magnetic precipitates is actually observed in the fuel with dechroming of the cladding material. (auth)

25023 FINITE ELEMENT FRACTURE MECHANICS ANALYSIS OF CREEP RUPTURE OF FUEL ELEMENT CLADDING. Chopra, P. S. (Argonne National Lab., Ill. (USA)). Nucl. Eng. Des.; 29: No. 1, 7-21(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A finite element fracture mechanics technique is applied for simulating the elevated creep rupture behavior of initially defected austenitic stainless steel fuel element cladding. The basic analytical approach consists of determining total instantaneous strain energy release rates G_T, and the corresponding values of the stress intensity factor K_T from sequential linear elastic finite element solutions and relating these to either an effective

creep fracture toughness parameter G_{cc} (or K_{cc}) or to creep crack growth rates da/dt, obtained from test results. An initial application of this approach has been made to simulate the creep rupture behavior of initially defected type 316 austenitic stainless steel fuel element cladding in the 20% cold worked condition, tested at 650°C. Current applications are aimed at the long-term cyclic creep fracture behavior of fast reactor fuel elements, using a nonlinear finite element code. In addition, multiple intergranular fracture configurations are being investigated. (auth)

25024 MATHEMATICAL TREATMENT OF HOT PRESSING OF REACTOR FUEL. Rashid, Y. R.; Tang, H. T.; Johansson, E. B. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Nucl. Eng. Des.; 29: No. 1, 1-6(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The general phenomenon of mechanical densification of uranium oxide fuel pellets, usually referred to as hot pressing, is characterized by plastic volume change exhibited by the fuel during reactor operations. Much of the fuel behavior under instantaneous plastic flow and creep, including crack healing and fuel redistribution, can be related analytically to hot pressing. This is examined along with the general problem of the elastic-plastic creep behavior of light water reactor fuel by first describing a mathematical model for the material's instantaneous and time-dependent inelastic response. This model is based on developing a yield potential function and flow rule which admit plastic volume changes. The yield potential function is essentially an extension of the von Mises yield condition to include a dependence on the first invariant of the stress tensor. Similarly a creep flow rule is postulated in which the creep hot pressing parameter is assumed to be constant and is related to Poisson's ratio. (auth)

25025 MATHEMATICAL MODELING AND ANALYSIS OF FUEL RODS. Rashid, Y. R. (General Electric Co., San Jose, Calif. (USA). Nuclear Energy Div.). Nucl. Eng. Des.; 29: No. 1, 22-32(Nov 1974).

From second international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A comprehensive method of analysis for nuclear fuel rods is presented by first developing appropriate constitutive relations for the fuel and the clad materials that take into account elastic-plastic behavior, primary as well as secondary creep, mechanical densification (hot pressing), fuel swelling, fuel cracking and healing, and fuel redistribution. The geometric problem is treated on the basis of a two-dimensional, axisymmetric, and plane model within the framework of the finite element method. General power histories of the transient, cyclic, and steady-state types are considered. Analysis results uncovering the importance of certain deformation processes and comparisons with experiments are given. (auth)

25026 HIGH PRESSURE ROD BUNDLE DNB DATA WITH AXIALLY NON-UNIFORM HEAT FLUX. Rosal, E. R.; Cermak, J. O.; Tong, L. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Nuclear Energy Systems Div.); Casterline, J. E.; Kokolis, S.; Matzner, B. (Columbia Univ., New York (USA). Dept. of Chemical Engineering). Nucl. Eng. Des.; 31: No. 1, 1-20(Nov 1974).

An extensive experimental program was performed to investigate departure from nucleate boiling (DNB) in electrically heated rod bundles simulating a nuclear power reactor fuel assembly. Effects on DNB due to non-uniform axial heat flux distribution, geometry of spacer grids (with and without mixing vane), length, and axial grid spacing along the rods were investigated. The experimental ranges were pressure: 1490-2400 psia; inlet temperature: 431-627°F; and mass velocity: $1.02-3.95 \times 10^6$ lb/hr ft^2. The 284 DNB data points obtained were compared with DNB heat fluxes predicted by the non-uniform heat flux W-3 correlation with a grid factor, based on local conditions calculated by the THINC computer code. This correlation accurately predicted the DNB heat fluxes in axially non-uniformly heated rod bundles, with a standard deviation of 7.4% and a mean deviation of +2.4% from the observed results. (auth)

25027 NUCLEAR REACTOR SPACER DEVICE. Carlson, R. C.; King, L. L.; Sofer, G. A. (to Jersey Nuclear Co.). US Patent 3,852,154. 3 Dec 1974. Filed date 4 Feb 1972. 10p.

A nuclear reactor fuel element spacer device for holding fuel elements in relatively fixed positions in a nuclear reactor core is disclosed which comprises, in combination, structurally improved peripheral support band, intersecting support strips connected to the peripheral support band and spring assemblies held in the desired positions by the intersecting support strips. (Official Gazette)

25028 A METHOD FOR DETERMINING THE BURN-UP DEPENDENCE OF FLUX FORM FACTORS ON SPENT REACTOR FUEL RODS FROM FISSION PRODUCT DISTRIBUTIONS. Knoth, J.; Schwenke, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany). Inst. fuer Physik). Atomkernenergie; 24: No. 2, 117-119(1974). (In German).

9 figs.; 4 refs.

The method finds out the long-term change of neutron flux in fuel rods from measured densities of fission products with different half-lives. In addition the procedure yields the axial maximum power profiles of the fuel rods. Results from the 1st Core of the NS OTTO HAHN are compared with theoretical predictions. (auth)

25029 BRITAIN: FUELLING THE NUCLEAR AGE. A Profile of British Nuclear Fuels Ltd. Trade and Ind.; 17: No. 12, 622-624(19 Dec 1974).

The principal activities of British Nuclear Fuels Ltd. are summarized. The activities are concerned with providing nuclear fuel services which include the conversion and enrichment of U, manufacture of U-based and Pu-based fuels, and provision of related fuel cycle services including the reprocessing of spent nuclear fuels. BNFL is involved in a number of international ventures in centrifuge technology, reprocessing, and transport. An outline is given of subsidiary and associated companies. Some examples of equipment and materials which have wider general applications are briefly discussed. Future plans are indicated. (UK)

Reactor Control Systems

Refer also to abstract 24933.

25030 (BMFT-FB-K-74-02) 300 MW PROTOTYPE OF NUCLEAR POWER STATION WITH FAST SODIUM-COOLED REACTOR SNR. Supplementary Project "Engineered Safeguards". Final Report. 'Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany); Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany); Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Nov 1974. 178p. (In German). INIS.

A subsidy was granted by the German Federal Ministry for Science and Education (Der Bundesminister fuer Bildung und Wissenschaft) by notice of Dec. 9, 1969 and notice of Dec. 15, 1970 for INTERATOM, for the program "SNR-Engineered Safeguards I". The authorization period ran from Jan. 1, 1969 up to March 31, 1971. Details are reported on the work completed in this program, divided into the following categories: basics, decay heat removal, shut-down system, and instrumentation and control systems. Parts of the program, which were not completed, are continued in the SNR-R and D program. (auth)

25031 (NJD-22) JOINT AGC-WANL XE ENGINE CONTROL SYSTEM FUNCTIONAL DESIGN REPORT. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1970. 127p. Dep. NTIS $9.50.

The XE-Engine Control System (ECS) is described from a functional design viewpoint. The objectives used in designing the ECS, which is a part of the Test Stand Control System (TSCS) for the XE nuclear rocket engine, were to provide flexibility in operational capability to explore startup characteristics, determine engine shutdown and pulse cooling characteristics, determine system dynamics at selected operating points, and evaluate engine control systems, subsystems and component performance; to provide for various modes of control (both automatic and manual) to evaluate candidate methods for NERVA; to utilize previous engine control system design experience developed during the NRX/EST program; and to demonstrate a flight type operational cycle. (auth)

25032 (RN-S-0450) HANDBOOK OF OPERATING AND MAINTENANCE INSTRUCTIONS FOR XE-1 ENGINE CONTROL SYSTEM. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1968. 438p. Dep. NTIS $25.00.

The XE Engine Control System (ECS) is designed to control the X-Engine during startup, power range, and shutdown phases of engine operation. The technology developed for the X-Engine will provide a technical basis for developing control concepts for the flight engine. The ECS has automatic control capability to program the engine system along a specified operating line. The ECS also provides additional manual controls to permit mapping of the engine, measurement of transfer functions, and backup control capability. Control at a given operating point

is obtained by position demands to the Reactor Control Drums and Turbine Power Control Valve. These demands are generated by the Chamber Temperature/Reactor Power and Chamber-Pressure Controls, respectively. It is the purpose of this handbook to describe the electronic circuits associated with the operation of these controls in their various automatic and manual modes. The ECS is constructed of solid-state electronic and electromechanical circuits. The ECS, in conjunction with the test stand control system (TSCS) and the Engine Safety System, provides for the safe, stable operation of the XE-1 nuclear engine. (auth)

25033 (WANL-TME-1083) NRX-A2 REACTOR CONTROL SYSTEMS. Merchant, C. C.; Norman, H. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Jan 1965. 64p. Dep. NTIS $6.25.

The reactor control systems used in the NRX-A2 test series are described with three objectives in mind: To document the reactor control systems in all pertinent detail, but in a form which is easier to follow than the typical control room prints; to show the performance of these control systems based on control room sanborn records, and to indicate the shortcomings in the reactor control systems which experience has identified, and the changes to be made prior to NRX-A3. Special emphasis has been placed on the automatic startup system because it is a relatively new concept and because several anomalies occurred during the NRX-A2 testing. It is concluded that: The phase margin of stability for the power control system can be improved by 12° (from 60° to 72°) by use of a more sophisticated filter in the log channel buffers; and the action of the auto start system can be made more consistent for slow transients by circuit simplifications and rearrangement of components. Schematic diagrams are presented of the new power controller, and the new temperature controller which will be built to satisfy the requirements of NRX-A3. (auth)

25034 ROLE OF DYNAMIC SIMULATION IN THE DEVELOPMENT OF NUCLEAR POWER PLANTS. Pearson, A. (Atomic Energy of Canada Ltd., Chalk River). pp vp, 13p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 5. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

The use of analog and digital computer systems for the simulation of nuclear power plant dynamics and control system requirements is described. (DCC)

25035 PULVERULENT ABSORBENT SAFETY ROD FOR A NUCLEAR REACTOR. Malaval, C. (to Groupement Atomique Alsacienne Atlantique). US Patent 3,840,432. 8 Oct 1974. Priority date 2 Jun 1972, France. 6p.

A pulverulent absorbent safety rod for a nuclear reactor is described which has a reservoir having three, superposed compartments. The lower compartment is situated in the core of the reactor and is filled with gas under pressure by way of a hollow, disconnectable rod. The intermediate compartment situated just above the core contains the absorbent and communicates with the lower compartment. The upper compartment situated in the reactor communicates with the intermediate compartment. When the hollow rod is disconnected, all the pulverulent absorbent falls into the lower compartment. (Official Gazette)

25036 CONTROL ROD DRIVE IN A NUCLEAR REACTOR. Maslenok, B. A.; Khegai, A. S.; Zlobin, V. G.; Mednitskii, V. G.; Genkin, L. I.; Petrichenko, N. F.; Mitrofanov, B. I. US Patent 3,852,153. 3 Dec 1974. Filed date 5 Apr 1972. 4p.

The invention relates to the control rod drive of a nuclear reactor. The drive according to the invention is characterized in that the arrangement to prevent spontaneous movement of the control rod of the nuclear reactor, which is located in the lower part of the containment casing of the drive. It is made in the form of a piston bearing against a rest face and housed in a circular chamber which is formed in the lower part of the containment casing and has in its upper portion a tapered surface for arresting the drive rod with the aid of wedging members, while at its bottom the chamber has the channels communicating with the reactor space, a partition tube being placed around the drive rod coaxially with the piston. This simplifies the design of the drive and raises its reliability under normal regulation and emergency protection conditions of the reactor. (Official Gazette)

25037 FLUIDIC SHUT-DOWN SYSTEM FOR A NUCLEAR REACTOR. Wilson, J. N.; Besant, R. W.; Barclay, F. W.; Frey, J. R. (to Atomic Energy of Canada Ltd.). Canadian Patent 955,694. 1 Oct 1974. vp.

A description is given of a nuclear reactor shut-down system comprising a fluidic vortex valve for releasably maintaining a liquid neutron poison outside of the reactor core, the poison being contained by a reservoir and biased by pressure for flow into poison tubes within the reactor. The upper ends of the poison tubes communicate with the supply port of the vortex valve. A continuous gas flow into the control port maintains normal controlled operation. Shut-down is effected by interruption of the control input. One embodiment comprises three groups of poison tubes and one vortex valve associated with each group wherein shut-down is effected by poison release in two out of the three groups. Preferably, each vortex valve comprises three control ports which operate on a "voting" or two-out-of-three basis. The vortex valves facilitate testing by momentary interruption of the control input and sensing poison motion. (CA)

25038 CONTROL SYSTEM DESIGN FOR NUCLEAR POWER. Browne, D. L. (Kaiser Engineers, Oakland, CA). Instrum. Technol.; 21: No. 9, 60-64(Sep 1974).

Balance-of-plant instrumentation for nuclear power plants can be readily handled by the process control engineer who equips himself by learning about such special requirements as radiation detectors and seismic sensors, AEC licensing procedures, and nuclear power plant terminology by studying the guides, codes, and standards published by government agencies and technical societies. Applicable design criteria, regulatory guides, and technical standards are listed. (DG)

25039 MODERN PROCESS COMPUTER CONFIGURATION FOR CONTROL PURPOSES IN NUCLEAR POWER PLANTS (WITH LIGHT WATER REACTORS). Graf, G.; Jansen, G. Energ. Tech.; 26: No. 9, 201-206(Sep 1974). (In German).

Following a clear consideration of the control tasks of a process computer in nuclear power plant, a new process computer concept for controlling functions is explained which ensures an optimum treatment of the tasks. The system configuration is based on a two-computer system with dynamically changeable task organization. The normal operation is designed to have functional task sharing. In the case of disturbances in the computer system, the essential tasks are carried out for the immediate information of the operating personnel by the intact computer for the duration of the disturbance. (auth)

25040 REACTOR REACTIVITY CONTROL BY COOLANT PASSAGE COATING. Wheelock, C. W. (to Energy Research and Development Administration). US Patent 3,860,482. 14 Jan 1975. Filed date 25 Sep 1957. 12p.

A method of controlling reactivity in a nuclear reactor is described. The water cooled reactor has coolant channels being of a metal selected from the group consisting of aluminum and stainless steel. A neutron absorbing solution consists of a cadmium compound selected from the group consisting of cadmium chloride and cadmium fluoroborate, together with hydrogen fluoride. The solution is about 3 molar in the cadmium compound and about 1 molar in hydrogen fluoride injecting the solution at a predetermined flux level into the water flowing through the coolant channels. (Official Gazette)

Nuclear Power Plant Economics

Refer also to abstract 24658.

25041 (COO-2391-1) STUDY OF DRY-TYPE COOLING TOWERS AND THEIR APPLICATION TO LARGE NUCLEAR POWER PLANTS. (Catalytic, Inc., Charlotte, N. C. (USA)). [nd]. Contract AT(11-1)-2391. 240p. Dep. NTIS $15.25.

The application of dry-type cooling towers is examined and evaluated from the following standpoints: (1) impact on the vendor industry, (2) surface protection for tower structural materials, (3) noise control, and (4) seismic design. (DG)

25042 (WASH-1288(Vol.1)(Summ.)) EVALUATION OF NUCLEAR ENERGY CENTERS. Volume 1. Summary. (USAEC, Washington, D. C.). Jan 1974. 23p. Dep. NTIS $4.00.

The objective of this study is to perform an analysis of nuclear energy centers to determine whether they offer any potential for meeting the Nation's energy requirements faster, cheaper or more effectively. Included in this overall objective is the need to assess the problems involved and weigh these against the potential advantages. This involves a critical evaluation of the need for nuclear energy centers, the desirability of the Federal Government's involvement, and what its role should be if it does become involved. For this study, nuclear energy centers are defined as large concentrations of nuclear power at a single geographical site. In addition, they may have an appropriate combination of related

facilities such as: waste management and storage facilities; fuel reprocessing plants; fuel recycle fabrication plants; new fuel fabrication plants; uranium enrichment plants; and process energy using industries. (auth)

25043 (WASH-1288(Vol.2)(App.)) EVALUATION OF NUCLEAR ENERGY CENTERS. Volume 2. Appendices. (USAEC, Washington, D. C.). Jan 1974. vp. Dep. NTIS $10.60.

Information is presented concerning a conceptual study for the Hanford Nuclear Energy Center; analysis of the Gulf States Utilities' River Bend site for a nuclear energy center; electricity transmission considerations; organizational, institutional and financial implications; radiological impact of a nuclear center on the environment; radioactive waste management for nuclear energy center; use of process energy from a nuclear energy center; description of commercial nuclear power plants; choice of reactor types for a nuclear energy center; regulatory aspects of siting nuclear power centers; uranium supply and demand considerations; and consideration of the rate of growth of the nuclear industry. (DCC)

25044 (WASH-1360) HEAT SINK DESIGN AND COST STUDY FOR FOSSIL AND NUCLEAR POWER PLANTS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Dec 1974. Contract AT(11-1)-2226. vp. Dep. NTIS $5.45.

The results of a comprehensive design and cost study conducted for various cooling systems (wet towers, ponds, dry towers, once-through systems) for fossil and nuclear power plants (LWR, LMFBR, HTGR) are presented. An optimization technique was used to determine the design and cost of each cooling system for each reference power plant considered. A sensitivity study for wet tower systems was conducted to include the effects of local variations in ambient temperatures, capital costs, replacement energy and capacity penalty charge rates, and salt water use. Environmental effects of the various systems are also discussed. (DG)

25045 ADDRESS BY A. J. O'CONNOR, PRESIDENT, JUNE 10, 1974. O'Connor, A. J. (New Brunswick Electric Power Commission, Fredericton, Can.). pp vp, 12p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 1. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

Activities of the CNA and of its committees during 1973–1974 are summarized, with mention of publications. The year was momentous, with announcements of orders for new nuclear plants for New Brunswick, Ontario and Quebec, and of export orders for Korea and Argentina. The flood of orders will create a shortage of manpower in the Canadian nuclear industry. Standardization of nuclear plants, national energy policy, uranium supplies, inflation, and public relations, are among topics discussed from a general point of view. (CA)

25046 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 5. Impact of Nuclear Energy on Industry. Toronto; Canadian Nuclear Association (1974). vp. (CONF-740681-P5; 74-CNA-500).

Separate abstracts are included for 3 of the 6 papers presented concerning the development of nuclear power plants and the availability and processing of uranium ores. Three of the papers have been previously abstracted and included in NSA, and they can be located in the NSA Report Number Index under CONF-740681-P5 and 74-CNA-500. (DCC)

For abstracts of individual papers see: 22606, 25034, and 25047.

25047 NUCLEAR ENERGY AND MANUFACTURERS. Panel Discussion. Johnston, R. C.; Harrington, J. E.; Meschino, J. L.; Williams, H. R.; Wood, R. M. pp Paper 505, 18p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 5. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

The design and manufacture aspects of power reactors and reactor components in Canada are reviewed. Cost considerations are discussed. (DCC)

25048 FISSION, FUSION, AND THE ENERGY CRISIS. Hunt, S. E. Oxford, Eng.; Pergamon Press (1974). 164p.

A book is presented whose chapters are titled as follows: living on capital; the atom and its nucleus, mass and energy; fission and the bomb; the natural uranium reactor; enriched reactors; control and safety; long-term economics—the breeder reactors and nuclear fuel reserves; short-term economics—the cost per kilowatt hour; national nuclear power programs; nuclear power and the environment; other applications of fission; and the fusion program. (UK)

25049 INS AND OUTS OF NUCLEAR POWER. Chapman, P. (Univ. of Open, Eng.). New Sci.; 64: No. 928, 866-869(7 Dec 1974).

Energy analysis of nuclear reactors to find out the energy implications of various nuclear policies shows that some nuclear programs will exacerbate fuel shortages. Such an analysis involves evaluating the energy ratio for a single nuclear reactor: that is the ratio of the energy produced in its lifetime to the energy required for its construction. Energy ratios for different types of reactors are given. The variation in net power when a reactor with an energy ratio of 10 is ordered every year is shown, from which it can be seen that the building program produces a net power output after 8.5 yr. Even when a nuclear power program shows a net energy profit, it may still be unacceptable because of the large fraction of output needed for new energy investment. From the results given it is considered that the rate of growth of nuclear reactors cannot be faster than a doubling time of 10 years if a positive energy contribution is required. The results are discussed with respect both to the relationship between energy analysis and economic analysis and also to the introduction of breeder reactors to replace the "burner" reactors. (UK)

25050 CHOICE OF THERMAL REACTOR SYSTEMS. Report of the Nuclear Power Advisory Board. London; Her Majesty's Stationary Office (1974). vp.

The Nuclear Power Advisory Board was asked to make recommendations on the choice of thermal reactor systems for the UK. The UK's nuclear background and forecasts of electricity demand up to 1990-91 are examined. Proposals are listed and considered in terms of safety and licensing and the technical, commercial and industrial factors affecting choice. The rates of build-up of nuclear programs possible with the main systems at acceptable levels of risk to the success of the program are discussed together with the implications for ordering of fossil stations. (auth)

25051 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 4. Export Market for Nuclear Products. Toronto; Canadian Nuclear Association (1974). vp. (CONF-740681-P4; 74-CNA-400).

Information on the export of nuclear reactors and radioactive products from Canada is presented. Two of the three papers presented have previously been evaluated for and included in NSA and can be found in the NSA Report Number Index under CONF-740681-P4 and 74-CNA-400. (DCC)

25052 ENERGETIC ANALYSIS OF STEAM AND GAS CYCLES IN THERMAL AND NUCLEAR POWER STATIONS. Buchet, E. (Univ., Liege). Rev. Gen. Therm.; 13: No. 152, 623-636(Aug 1974). (In French).

The various classes of losses, and the work output, and the energy balances of the following cycles are studied: theoretical steam cycles (Rankine, re-superheating or bleeding cycle, or a combination of both), actual cycles, theoretical gas cycles (single, recovery type), actual cycles, and combined gas-steam cycles. An equivalence is established between the various theoretical cycles and a Carnot cycle. The thermal efficiencies of the various alternatives of the steam cycles used in nuclear power stations (gas cooled reactor, pressurized water reactor, boiling reactor) are calculated. (FR)

25053 STEAM SUPPLY BY NUCLEAR POWER PLANT. Krivine, G. (Electricite de France, Paris). Rev. Fr. Energ.; 25: No. 265, 167-172(Aug 1974). (In French and English).

Three of the methods presently under study at Electricite de France for supplying industry with process steam from nuclear power plants are discussed: removing steam from ahead of the turbine, back-pressure turbine, and removing steam from the turbine. Cost figures are given. (FR)

25054 ENERGY IN THE YEAR 2000. Gibrat, R. Sci. Tech. (Paris); No. 14, 7-15(15 May 1974). (In French).

The great options of the twenty-first century are outlined regarding energy. HTR's, fast breeders, and hydrogen lead the way for a fully nuclear solution in the year 2000 to solve the problems of resources and national economic self-sufficiency, and thereby eliminate the yoke of fossil fuels. In the event of delay or failure, far-away solutions: solar energy, geothermal energy, and nuclear fusion in particular should be readied to take over for an almost unlimited duration. Technical, human, and climatological problems are examined with a view to the limitations they may impose on energy solutions. (FR)

25055 NUCLEAR ENERGY FOR ENERGY AND RAW MATERIAL SUPPLY. Schulten, R.; Kugeler, K.; Barnert, H. (Kernforschungsanlage, Juelich, Ger.). Rev. Fr. Energ.; 25: No. 265, 237-252(Aug 1974). (In French and English).

The market for fossil primary energy in the Federal Republic of Germany is discussed. Nuclear energy costs compare favorably with the prices of fossil energy in Europe. Because of the high temperature of nuclear heat energy supplied from high-temperature reactors, the high-temperature reactor is suited for process-heat applications. The HTR, developed in the Federal Republic of Germany, uses spherical fuel elements, which are packed into the pebble-bed core. Nuclear coal gasification is a process presently developed to simultaneously convert the energy of coal and nuclear energy from high-temperature reactors into a readily applicable and usable form of energy. The long distance supply of nuclear energy is a process for the conversion of nuclear energy into an energy easy to transport and ready for application. A transportable energy is the latent chemical energy of chemically reacting material, for example, the chemical energy of a latent heat gas which is transported. The readily applicable form of energy is hot water and steam. Nuclear water splitting is a process for direct conversion of nuclear energy into the chemical energy of hydrogen, the universal energy carrier. The components of this process are nuclear-produced high-temperatures and water. The main product is hydrogen; a useful by-product is oxygen. (FR)

25056 NEW FRENCH NUCLEAR PROGRAMME. Girard, Y. Develop. Ind. Sci.; No. 20, 6-9(May 1974). (In French).

By authorizing Electricite de France to start building thirteen 900 MW nuclear power stations in 1974 and 1975, the Government has launched the new French nuclear program. It is shown that the decision of the Government reflects a choice made at the close of a complex analysis: economic data on nuclear electricity production; access to nuclear matter and fuels; industrial capacities; control of environmental nuisances and risks; and financing. The new program should transform the energy balance, with nuclear energy covering 9% of requirements in 1980 and 28% in 1985. (FR)

25057 NATURAL DRAFT TOWERS IN NUCLEAR POWER STATIONS. Blanquet, J. C. (Societe de Condensation et d'Applications Mechaniques, Paris). Ind. At. Spatiales; 18: No. 2, 13-22 (Mar 1974). (In French).

Cooling tower usefulness in nuclear plants is discussed. A parallel between water needs of conventional thermal plants and those of nuclear power plants is drawn, and it is demonstrated that in spite of the huge amount of water needed by nuclear facilities, the installation of cooling towers is not an overwhelming problem. Cooling tower size is unrelated to water flow, and cooling tower construction technology is well-established. The problem of environmental effects particularly that of droplet fallout is tackled. Very recent research has permitted implementation of techniques limiting the previously-ascertained fallout to 1%. Conclusions indicate the need to use cooling towers and corroborate their efficiency. (FR)

25058 HEAVY WATER FIASCO: THE HIDDEN COSTS OF CANADA'S NUCLEAR PLANTS. Carruthers, J. Sci. Forum; 6: No. 6, 3-6(Dec 1973).

The cost of building heavy water plants is claimed not to be included in the figures that are commonly presented by the Canadian nuclear power industry to show that nuclear electric plants are competitive with fossil-fuelled electric generating plants. Insufficient attention is being paid to the need for the actual power consumer to amortize the cost of heavy water production. (CA)

25059 PROCEEDINGS OF THE SPECIAL SESSION ON NUCLEAR MANPOWER OVERVIEW. American Nuclear Society Winter Meeting, Washington, DC, October 27–31, 1974. ANS Special Publication 7401. Hinsdale, IL; American Nuclear Society, Inc. (1974). vp. (CONF-741087-). $10.00.

Nine papers dealing with the projected nuclear manpower shortage are presented. A reprint of an article on the impending nuclear manpower crisis from the June 1974 issue of Nuclear News and the results of an engineering manpower survey are also presented. Each of the above was separately abstracted and indexed for NSA. (DG)

For abstracts of individual papers see: 25060–25070.

25060 NUCLEAR MANPOWER CRISIS AHEAD. Deutsch, R. W.; Whitney, J. W. (General Physics Corp., Columbia, MD). pp v-xii of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

Nuclear manpower requirements are discussed in light of projected power plant construction and operation schedules, and a manpower shortage is predicted. Recommendations for meeting the anticipated manpower needs are made. (DG)

25061 ENGINEERING MANPOWER NEEDS: A SURVEY. Wilson, W. E. (Washington State Univ., Pullman). pp xiii-xv. of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

The results of a nuclear-oriented engineering manpower survey of the nuclear power industry are presented and discussed. Areas of academic training are also ranked in the order of importance as indicated by the nuclear power industry. (DG)

25062 DIMENSIONS OF THE PROBLEM. Chewning, J. S.; Barker, L. L. (Atomic Energy Commission, Washington, DC). pp 1.1-1.25 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

Shortages of qualified engineers now permeate the entire nuclear power field, due to the overall lag in engineering enrollments and to the increasing complexities of design, licensing and construction. Growth in nuclear products manufacturing is also reducing the available manpower pool. Compounding the problem will be the rapid and far-reaching actions required for Project Independence. (auth)

25063 CONSTRUCTION MANPOWER ASPECTS OF NUCLEAR POWER STATIONS. Nagle, E. C.; Gray, G. E. (United Engineers and Constructors Inc., Philadelphia). pp 2.1-2.16 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

Construction scheduling requires deft treatment to avoid crews delayed by needed materials and decisions. Ideally, engineering should be 60% complete prior to Construction Permit. Craftsmen are in the position that the better they work, the quicker they may be unemployed. Wiser handling of the available manpower, materials and decisions are needed with labor being treated as a partner. (auth)

25064 ACHIEVING A BALANCE BETWEEN THE DEMANDS OF THE REGULATORY PROCESS AND THE DESIGN/CONSTRUCTION PROCESS. Brush, H. F. (Bechtel Power Corp., San Francisco). pp 3.1-3.15 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

The manpower required to engineer and construct a nuclear power plant has been greatly increased by both the technical impact and the procedural requirements of the regulatory process above what was required just a few years ago. This places a major demand on the financial, manpower and supply sources used by the utility industry. The manpower situation is tight and will remain so despite the cutbacks in construction which have been made by utilities. A possible way to arrest or reverse the trend toward increasing design and procedural complexity is for industry and the AEC together to make effective use of the recently completed Reactor Safety Study (WASH-1400) and of the AEC's drive toward standardization. (auth)

25065 WHAT IS THE NUCLEAR INDUSTRY DOING? WHAT MUST IT DO? Deutsch, R. W. (General Physics Corp., Columbia, MD). pp 4.1-4.15 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

The shortage of trained manpower for the nuclear industry cannot be satisfied by conventional training sources. If the industry hopes to meet the country's current nuclear commitments, the major employers of trained personnel in the industry should consider training personnel along lines originated by the U. S. Navy. In particular, architect-engineers should join the utilities in adopting entry-level training programs to satisfy their manpower and training requirements. It will be necessary for the nuclear industry to invest in innovative instructional techniques, build training centers and utilize professional instructional staffs. The costs for such training programs should be shared proportionally by the industry. (auth)

25066 TECHNICAL TRAINING FOR UTILITY AND DESIGNER STAFF AT A NSSS DESIGNER ORGANIZATION. Grady, J. D. (Westinghouse Electric Corp., Pittsburgh). pp 5.1-5.13 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

Training for those involved in the design, construction, management, regulation and upkeep of nuclear power plants has become necessary as the nuclear power industry grows and the number of positions filled with previously non-nuclear experienced personnel increases. Efforts of the Westinghouse Electric Corporation to meet manpower needs are summarized. Courses are being presented for the many levels of management and engineering personnel to meet their training requirements, ranging from conceptual understanding to detailed knowledge of the nuclear power plant. For the power station technical staff, courses are being presented and kept under continual development to insure a sufficient number of trained personnel to provide proper plant guidance and upkeep. (auth)

25067 WHAT CAN UNIVERSITIES DO? WHAT ARE THEY DOING NOW? Long, R. L. (Univ. of New Mexico, Albuquerque). pp 6.1-6.8 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

A discussion is presented of ways in which universities have been involved in anticipating and preparing for the large manpower demands brought about by the national move toward energy self-sufficiency. Special efforts directed to recruitment of minorities and women are described. The vital need for university, industry, and government cooperative efforts is emphasized. (auth)

25068 UPGRADING PERSONNEL THROUGH ORGANIZATION DEVELOPMENT AT AN NSSS DESIGNER ORGANIZATION. Arnold, W. H.; Gibson, D. J. (Westinghouse Electric Corp., Pittsburgh). pp 7.1-7.8 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

The organization development effort in Westinghouse PWR Systems Division is a long-range program of changing the organizational climate and modes of behavior to improve productivity and promote development of employees. Interdepartmental, multi-level study teams examined all aspects of interdepartmental cooperation, communication, and personal development. Their findings and recommendations are being applied in a series of action programs that build toward a goal model, which includes a climate of trust, openness of communication, participativeness, a spirit of achievement, and enhanced ability to change. Some of the rationale, goals, process, and unique elements of content of the program are described, as well as the expected long-range gains. (auth)

25069 TECHNICIANS TRAINED TO WORK WITH RADIOISOTOPES WILL RELIEVE ENGINEER SHORTAGE. Walters, J. H. (Univ. of Florida, Gainesville); Wetz, J. E.; Holland, E. F. pp 8.1-8.7 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

Central Florida Community College began training environmental monitors in its two year Radiological Health Technology program in 1965. Each May 1974 graduate had at least six job offers. Seventy-two graduates, male and female, black and white, have completed the program since 1965; sixty-nine of these are still working in their discipline. This fall, Central Florida has acquired a small nuclear reactor, and will begin training Reactor Operators. Both Radiation Monitors and Reactor Operators perform technical level functions which will free nuclear engineers for doing more professional functions. (auth)

25070 AMERICAN NUCLEAR SOCIETY MANPOWER SURVEY PROJECT. Wang, C. H. (Oregon State Univ., Corvallis). pp 9.1-9.6 of Proceedings of the Special Session on Nuclear Manpower Overview. Hinsdale, IL; American Nuclear Society, Inc. (1974).

From meeting on nuclear manpower overview; Washington, District of Columbia, USA (27 Oct 1974). See CONF-741087-.

In view of the serious manpower shortage problem projected for the nuclear industry, an ad hoc committee has been appointed to plan and to implement a comprehensive and in-depth manpower supply/demand survey. The project, to be sponsored by external funds, will make use of specially designed questionnaires as well as conduct detailed personal interviews. Approximately two hundred educational institutions and three hundred industrial organizations as well as federal military establishments will be contacted for information on manpower supply. Similarly, approximately 4,600 organizations encompassing utilities, architect-engineers, constructors, manufacturers, government agencies, government-owned contractor-operated laboratories, military operations, medical operations, and educational institutions in the broad nuclear field will be contacted to collect information on manpower demand. The findings will be analyzed and published for wide distribution in the hope that they will lead to the devisal of a comprehensive plan to assure adequate supply of manpower in nuclear areas for many years to come. (auth)

25071 NEED FOR NUCLEAR POWER. McLeod, N. B. pp 4-9 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

Topics discussed include total and electrical energy growth rates, ultimate environmental restraints that will limit energy demand growth, principal economic incentives for nuclear power, and the availability and price of uranium. (JWR)

25072 NUCLEAR POWER STATION COSTS. Scarborough, J. C. pp 10-53 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

Station capital costs, station schedules, fuel cycle costs, and operating costs are all examined. Current cost estimations and future cost projections are discussed. (JWR)

25073 FRANCE'S NUCLEAR POLICY AND EUROPE. Com. Naz. Energ. Nucl., Notiz.; 20: No. 10, 86-97(Oct 1974). (In Italian).

France's nuclear policy in the context of that of the EEC is fully discussed. In particular, comparisons are made between the French and German situations. Activities in the field of fuel and power reactors are widely dealt with. A particular emphasis is given to the growing industry developed in the field of fuel fabrication and reprocessing, on national and international scale. The problems of uranium enrichment are widely dealt with, together the activities which are being carried out in Europe in this field (Eurodif, Urenco/Centec). (auth)

25074 POWER FROM POWER: A NEW SCENARIO EMERGES FOR INDIA'S SCIENTISTS. Anderson, R. S.; Morrison, B. M. (Univ. of British Columbia, Vancouver). Sci. Forum; 7: No. 6, 10-13(Dec 1974).

India's nuclear power development program has been active since the early fifties. A power generation development program, based on natural uranium, was prepared soon after the creation in 1954 of the Department of Atomic Energy. The first nuclear power plant at Tarapur in the early sixties was followed by a CANDU-type reactor for its second power station at Rana Pratap Sagar. The attempt to achieve a high degree of "self-reliance" has enabled India to develop its nuclear industry and establish an export market for nuclear fuel and radiation equipment. It also made possible the nuclear test in May, 1974. (CA)

25075 NUCLEAR POWER ENGINEERING: ANALYSIS OF TRENDS IN POLICY AND TECHNOLOGY. Olds, F. C. Power Eng.; 79: No. 1, 16-17(Jan 1975).

Reactor Fuel Cycle Economics

Refer also to abstract 25072.

25076 (INIS-mf-1383, pp 93-100) ANALYSIS OF ON-LOAD REFUELING IN NUCLEAR REACTORS. Savander, V. I.; Ivanenkov, G. V. 1973. (In Russian).

Problems in the optimization of fuel reloading regimes in reactors are examined. The equilibrium states of reactors during use of the regime of continuous per-channel reloading and axial movement of the fuel both in one and opposite directions (regime of n-zone forcing through) are studied. A reactor in the form of an infinite plate without reflector is examined in the one-group diffusion approximation. Discontinuities in the reactivity during fuel reloading at each moment are assumed to be negligibly small. The following basic parameters of the equilibrium states are studied: dependence of the multiplication factor on the degree of burnup, dependence of the degree of burnup on the critical dimensions of the reactor, and dependence of the coefficient of inhomogeneity of the neutron field on the degree of burnup. (tr-INIS)

25077 NUCLEAR FUEL INDUSTRY. McLeod, N. B. pp 66-82 of Scope of the International Nuclear Industry. Jones, C. F. Rockville, MD; NUS Corp. (1972).

From atomic industrial forum international conference; Washington, District of Columbia, USA (12 Nov 1972). See CONF-721158-.

The organizational, functional, and economic features of the nuclear fuel industry are summarized, and those features and other factors that have a present bearing on the issue of long-term assurance of a reasonably-priced nuclear fuel supply are reviewed. (auth)

25078 WHAT IS THE PRESENT STATUS OF THE NUCLEAR FUEL CYCLE. Jelinek-Fink, P. (Nuklear-Chemie und-Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). VGB Kraftwerkstechnik; 54: No. 10, 633-639(Oct 1974). (In German).

The development of different reactor concepts has been accompanied by corresponding developments in fuel element technology. The various stages in the fuel cycle—uranium procurement, enrichment, reprocessing and waste disposal—are described in detail. (auth)

Reactor Licensing and Regulation

Refer also to abstracts 24928, 25064, and 25110.

25079 (DOCKET-50171-186) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Semiannual Operating Report, July–December 1974. (Philadelphia Electric Co., Pa. (USA)). 28 Feb 1975. 25p. Dep. NTIS $4.25.

The station operated at power between July 6, and October 31, 1974, with the exception of a shutdown to perform reactivity measurements. On October 31, 1974, the plant was shutdown for decommissioning. At shutdown, Core 2 burnup was 897.4 equivalent full power days. A histogram of reactor power for 1974 is presented. Summaries are given for power operations to date, safety and safety actions, radioactive releases, radiation data, contamination data, maintenance, facility changes, and administration. (FS)

25080 (DOCKET-50245-484) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Semiannual Operating Report, July–December 1974. (Northeast Nuclear Energy Co., Hartford, Conn. (USA)). 26 Feb 1975. 42p. Dep. NTIS $5.25.

During this reporting period net electric production was 1,480,745 MWH. The plant operated with an efficiency of 32.3% and availability of 62.57%. Data summaries are presented on reactor operation, shutdowns, abnormal and other significant events, personnel radiation exposures, radioactive effluents, environmental sampling, monitoring programs, and instrument and mechanical electrical maintenance. Power generation and plant performance statistics are presented. (FS)

25081 (FIND-50219) FIND: OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Williams, W. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 40p. Dep. NTIS $4.00.

This index is presented for microfiche material of Docket 50219, Oyster Creek Nuclear Power Plant, and includes Items 1-604, dated Mar. 26, 1964–Oct. 28, 1974. Special emphasis is placed on the material dated subsequent to the issuance of the Provisional Operating License on Apr. 9, 1969. (auth)

25082 (FIND-50245-R1-S1) FIND: MILLSTONE NUCLEAR POWER STATION, UNIT 1. Horn, F. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Dec 1974. 18p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

25083 (FIND-50275-S1) FIND: DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Williams, W. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Jan 1975. 31p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

25084 (FIND-50471(12-74)) FIND: PILGRIM NUCLEAR POWER STATION, UNIT 2. Horn, F. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Dec 1974. 40p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

25085 (NP-20313) STANDARD NUCLEAR QUALITY ASSURANCE PROGRAM. (Stone and Webster Engineering Corp., Boston, Mass. (USA)). 31 Dec 1974. vp. TIC.

The nuclear quality assurance program of Stone and Webster Engineering Corporation is presented in detail. The program includes: engineering and design control; procurement document control; control and identification of purchased material and equipment; control of special processes; inspection; test control; handling, storage, and shipping; corrective actions; and audits. (JWR)

25086 (NUREG/PRDI-75/1) POWER REACTOR DOCKET INFORMATION. (USERDA Technical Information Center, Oak Ridge, Tenn.). Jan 1975. 71p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the U. S. Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

25087 (NUREG/PRDI-75/2) POWER REACTOR DOCKET INFORMATION. (USERDA Technical Information Center, Oak Ridge, Tenn.). Feb 1975. 49p. TIC $1.85.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Nuclear Regulatory Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by power plant name. (JWR)

25088 (RDT-F-2-4T(12-74)) QUALITY VERIFICATION PROGRAM REQUIREMENTS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Dec 1974. 6p. RSO Free.

25089 (RDT-M-5-4T(01-75)) NICKEL–CHROMIUM–IRON ALLOY PLATE, SHEET, AND STRIP (ASME SB-168 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1975. 6p. RSO.

Supplementary requirements pertaining to purchase specifications, testing and analysis procedures and methods, and purchaser-specified optional provisions for examination, marking, and cobalt content limitations are presented. (DG)

25090 (RDT-STATUS-(1-75)) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of January 31, 1975. (USAEC Division of Reactor Research and Development, Washington, D. C.). 19 Feb 1975. 68p. NRC.

25091 (RDT-STATUS-12-74) BIMONTHLY STATUS REPORT OF RDT STANDARDS. Summary as of November 27, 1974. (USAEC Division of Reactor Research and Development, Washington, D. C.). 27 Dec 1974. 53p. RSO.

25092 (REG/G-1.16(Rev. 3)(01-75)) REPORTING OF OPERATING INFORMATION: APPENDIX A TECHNICAL SPECIFICATIONS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 13p. DRS Free.

The reporting requirements are presented for technical specifications for nuclear power plant operations involving health and safety. (DCC)

25093 (REG/G-1.70.1(Rev.1)(01-75)) ADDITIONAL INFORMATION: HYDROLOGICAL CONSIDERATIONS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 1p. DRS Free.

Guidelines are presented concerning the provision of additional information concerning hydrology at nuclear power plant sites. (JWR)

25094 (REG/G-1.70.17(01-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: HYDROLOGIC ENGINEERING. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 13p. DRS Free.

A standard format for the safety analysis report requirements for the hydrologic engineering of nuclear power plant sites is presented. Information needed by the Regulatory staff in order to conduct its safety evaluations is identified. (DCC)

25095 (REG/G-1.70.18(01-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: MECHANICAL SYSTEMS AND COMPONENTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 12p. DRS Free.

A standard format for the safety analysis report requirements for nuclear power plant mechanical systems and components is presented. Information needed by the Regulatory staff in order to conduct its safety evaluations is identified. (DCC)

25096 (REG/G-1.70.19(01-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: STEAM GENERATORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 4p. DRS Free.

A standard format for the safety analysis report requirements for PWR steam generators is presented. Information needed by the Regulatory staff in order to conduct its safety evaluations is identified. (DCC)

25097 (REG/G-1.70.20(01-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: REACTOR COOLANT PRESSURE BOUNDARY MATERIALS AND INSERVICE INSPECTION. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 6p. DRS Free.

A standard format for the safety analysis report requirements for BWR and PWR cooling system materials and inservice inspection is presented. Information needed by the Regulatory staff in order to conduct its safety evaluations is identified. (DCC)

25098 (REG/G-1.70.21(01-75)) INFORMATION FOR SAFETY ANALYSIS REPORTS: REACTOR VESSELS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 3p. DRS Free.

A standard format for the safety analysis report requirements for reactor vessels is presented. Information needed by the Regulatory staff in order to conduct its safety evaluations is identified. (DCC)

25099 (REG/G-1.75(Rev. 1)(01-75)) PHYSICAL INDEPENDENCE OF ELECTRIC SYSTEMS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 2p. DRS Free.

A method acceptable to the Regulatory staff of complying with IEEE Std 279-1971 and Criteria 3, 17, and 21 of Appendix A to CFR Part 50 is described with respect to the physical independence of the circuits and electric equipment comprising or associated with the Class IE power system, the protection system, systems actuated or controlled by the protection system, and auxiliary or supporting systems that must be operable for the protection system and the systems it actuates to perform their safety-related functions. This guide applies to all types of nuclear power plants. (auth)

25100 (REG/G-1.81(Rev. 1)(01-75)) SHARED EMERGENCY AND SHUTDOWN ELECTRIC SYSTEMS FOR MULTI-UNIT NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 1p. DRS Free.

This regulatory guide describes a method acceptable to the NRC staff for complying with the Nuclear Regulatory Commission's requirements with respect to the sharing of onsite emergency and shutdown electric systems for multi-unit nuclear power plants. With respect to the sharing of d.c. systems, this guide applies to all multi-unit plants. With respect to the sharing of a.c. systems, this guide applies to the multi-unit plants whose a.c. power is supplied by diesel generators. (auth)

25101 (REG/G-1.91(01-75)) EVALUATION OF EXPLOSIONS POSTULATED TO OCCUR ON TRANSPORTATION ROUTES NEAR NUCLEAR POWER PLANT SITES. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jan 1975. 6p. DRS Free.

A method acceptable to the Regulatory staff for determining safe distances from a nuclear power plant to a transportation route over which explosive material (not including gases) may be carried is described. (auth)

25102 (RP-8(Amend.1)) TOPICAL REPORT RP-8, AMENDMENT 1 CONSISTING OF RESPONSES TO QUESTIONS. (Stone and Webster Engineering Corp., Boston, Mass. (USA)). 22 Nov 1974. 86p.

25103 CANADIAN NUCLEAR ASSOCIATION FOURTEENTH ANNUAL INTERNATIONAL CONFERENCE, MONTREAL, CANADA, JUNE 9–12, 1974. Volume 1. President's Address; CNA Committee Reports. Toronto; Canadian Nuclear Association (1974). vp. (CONF-740681-P1; 74-CNA-100).

Separate abstracts are included for 2 of the 9 sections presented concerning activities of the Canadian Nuclear Association. One of the remaining seven sections was evaluated for NSA and can be found in the NSA Report Number Index under CONF-740681-P1 and 74-CNA-100. (DCC)

For abstracts of individual sections see: 25045 and 25104.

25104 ANNUAL REPORT: CNA CODES, STANDARDS, AND PRACTICES COMMITTEE. Hake, G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp vp, 5p of Canadian Nuclear Association Fourteenth Annual International Conference, Montreal, Canada, June 9–12, 1974. Volume 1. Toronto; Canadian Nuclear Association (1974).

From 14th annual conference on nuclear reactors; Montreal, Canada (9 Jun 1974).

The following codes have been issued under the auspices of the Canadian Standards Association: Z-299 quality assurance and quality control requirements for electric power generation; N-285 code for CANDU nuclear power plant components including periodic inspection; N-287 code for concrete containment structures for CANDU reactors. Some difficulties in establishing standards are mentioned. (CA)

25105 NOTIFICATION CONCERNING THE FORMATION OF THE REACTOR SAFETY COMMISSION (RSK). IRS Kurz-Inform., Reihe C; No. 18, 1-2(Sep 1972). (In German).

List of members of the Reactor Safety Commission, newly appointed by the Secretary of the Interior of the German Federal Republic in Sept 74, is presented. (GE)

25106 RECOMMENDATIONS OF THE REACTOR SAFETY COMMISSION (RSK) PRESENTED AT ITS 93rd MEETING ON APRIL 24, 1974. Bundesanzeiger; 26: No. 144, 1-6(Aug 1974). (In German).

Guidelines for PWRs summarize the safety engineering requirements which, according to the RSK, should be met in construction and operation of PWRs. The ad-hoc programme for investigating welding problems with pressure vessels is described. Further operation of the MZFR with enriched uranium until the present stock of fuel has been spent (approximately until end of 1977) is discussed. Design of pipings for sodium-cooled reactors (KNK II and SNR-300) is reviewed. Comments on the expert opinion by Cottrell concerning the integrity of pressure vessels are presented. (GE)

25107 EBASCO NUCLEAR QUALITY ASSURANCE PROGRAM MANUAL. New York; Ebasco Services Inc. (1974). 156p. (NP-20319; ETR-1001).

The manual presented represents the Ebasco Quality Program policy and requirements for the design and construction of nuclear power stations under the jurisdiction or in accordance with the requirements of the United States Atomic Energy Commission. (auth)

GENERAL AND MISCELLANEOUS

Energy Utilization and Economics

Refer also to abstract 22601.

25108 (NP-20309) TWENTY-SECOND ANNUAL REPORT, 1973-1974. (Australian Atomic Energy Commission, Coogee). 30 Jun 1974. 116p. Dep. NTIS (US Sales Only) $9.00.

Nuclear power programs of most major countries continue to lag behind schedules due to delays from environmental issues, licensing procedures, and construction and management problems. Some comparisons are made for worldwide energy resources, both nuclear and conventional. Australia has relatively large fossil fuel resources and is not under duress to develop nuclear power. The Commission is engaged, however, in developing licensing and regulatory procedures in relation to nuclear power plants and in developing safety criteria and standards. The operations of the Commission for the year ended June 30, 1974, are discussed in the following chapters: The Role of Nuclear Power as an Energy Resource; Uranium; Uranium Fuel Cycle; Uranium Enrichment; Radioisotopes and Radiation; General Nuclear Science; Research Establishment Operations and Services; and International Relations and Safeguards. A chapter on general subjects covers legislation, information services, and staff activity for the year. (MCW)

25109 NEW SCOPE IN NUCLEAR ENERGY: THE PRODUCTION OF HYDROGEN FROM WATER. Pottier, J. (Gaz de France, Paris); Souriau, D.; Rastoin, J.; Courvoisier, P. Rev. Fr. Energ.; 25: No. 265, 143-161(Aug 1974). (In French and English).

The system allowing the distribution of nuclear energy to users in two forms is envisaged, the first form being electrical power supply and the second one a cheap fuel (hydrogen) likely to be stored and transported in great quantities. The possibilities for producing hydrogen in two manners are exposed. Electrolysis from electric power plants and direct conversion of heat produced by a high-temperature reactor into hydrogen using a deoxidation sequence are envisaged. The problems connected with the development of a hydrogen system (transportation, storage and uses) are reviewed. (FR)

Information Handling

25110 (NP-20315) NUCLEAR ENVIRONMENT INFORMATION: RESOURCES AND ACTION PLAN. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). Sep 1974. vp. Atomic Industrial Forum, Inc., New York $10.00.

For Atomic Industrial Forum, Inc.

An evaluation by Arthur D. Little of environmental information needs, resources, and capabilities currently existing in the continental United States is presented. Specific recommendations are made to the Atomic Industrial Forum and its members as to how they might best develop a clearinghouse for Environmental Reports information. Needs discussed include those for an information guidebook, a current awareness service, an information science staff, training programs, and specialized data bases. (MCG)

25111 SEMINAR ON THE DESIGN OF ENVIRONMENTAL INFORMATION SYSTEMS, KATOWICE, POLAND, 1973. Deininger, R. A. (ed.). Ann Arbor; Ann Arbor Science Publishers, Inc. (1974). 432p. $24.50.

Papers are presented on the status of environmental information services around the world. Topics include general information systems, air pollution control, water pollution control, solid waste management, information systems in Poland, and activities of international organizations. Specific information is provided on ambient air quality, air pollution measurements, water quality measurements, monitoring programs, refuse disposal planning, research needs, computer systems, the Economic Commission for Europe, and the World Meteorological Organization's monitoring systems. (auth)

Law

Refer also to abstract 22972.

25112 GOVERNMENT BILL: BILL INTRODUCED BY THE GERMAN FEDERAL REPUBLIC FOR THE AMENDMENT OF THE ATOMIC ENERGY LAW. Bundesrat-Drucksache; No. 351, 1-30(May 1974). (In German).

The purpose of the bill is to amend the German Atomic Energy Law in accordance with the Paris and Brussels Conventions on Third Party Liability in the Field of Nuclear Energy, which are to be ratified by the German Parliament, and to prevent any deterioration of the national law due to the ratification, but rather to improve the existing regulations in the interest of the peaceful uses of nuclear energy. This is to be achieved by: (1) amending and modifying those stipulations of the Atomic Energy Law which will be affected by the Conventions to be ratified, (2) extensively making use of the reservations expressed by the FRG on the occasion of the signing of the Conventions in order to achieve better protection of victims, (3) increasing the present maximum extent of liability from 500 million DM to a thousand million, (4) increasing the present sum to cover liabilities from 120 million DM to 500 million and, (5) shifting the present obligation of the Federal Government to release from obligations in the range of 120 to 500 million DM to a sum of 500 million DM up to a thousand million, with the Laender assuming part of the responsibility as well. (auth)

25113 RADIATION PROTECTION LAW IN THE GDR. Ifflaender, G. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin). Kernenergie; 17: No. 8, 248-253(Aug 1974). (In German).

Substance and tasks of radiation protection law in the GDR are described, the aim of which is prevention of injuries of man and damages in materials. The responsibility of the State Board for Atomic Safety and Radiation Protection referring to the care of concerns of protection against ionizing radiation in country-wide scale, to licensing, and to radiation protection monitoring is discussed. Within individual institutions the authority in charge and managing personnel as well as the health physics officer are responsible for observance and surveillance of radiation protection measures. As to the liability in case of radiation damage or injury the principle of liability from sources of higher danger—endangering liability—applies which ensures higher safety of workers in nuclear installations and in handling radioactive materials. Fundamental provisions concerning radiation protection in the GDR are based on recommendations of the Internal Commission on Radiation Protection. Regulations in preparation are mentioned. (auth)

Management

Refer also to abstracts 22595 and 22971.

25114 (AGC-1747) RESEARCH AND DEVELOPMENT CAPABILITIES AND INTERESTS. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 136p. Dep. NTIS $10.00.

The experience of the Aerojet-General Corporation in the design, development, and production of liquid- and solid-propellant rocket engines, ordnance, guidance systems, and supporting programs is reviewed. Testing facilities are located at the Azusa Plant, the Covina Plant, the Liquid and Solid Rocket Plants, the Downey Plant, and Aerojet-General Nucleonics in California and the Atlantic Division Plant in Maryland. Facilities are available to perform research, development, and testing in the fields of rocket engines, space technology, infrared equipment, advanced chemistry, systems analysis, electronics, underwater propulsion devices, structural materials, and power-generating systems; design and fabrication of electrical, electronic, and pneumatic instrumentation and control equipment; design and development of drone systems, penetrating systems, and decoy missile systems; automation, underwater communications, and airborne instrumentation; rocket-engine design, development, and manufacturing; and nucleonics. Some financial data are presented. (MCW)

25115 (AGC-1747(Ed.3)) RESEARCH AND DEVELOPMENT CAPABILITIES AND INTERESTS. Third Edition. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1963. 191p. Dep. NTIS $12.75.

Information is presented on plant facilities and capabilities of organizations at Azusa, Covina, and Downey. Also included is information on the liquid rocket plant, the solid rocket plant, security status, and contract experience. Other sections are included on Aerojet-General Nucleonics and Space General Corporation. (JRD)

25116 (AGC-1920) INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAM, 1961. (Aerojet-General Corp., Azusa, Calif. (USA); Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1961. 140p. Dep. NTIS $10.00.

Procedures used in initiation and control of research and development programs and in controlling costs are described. A summary is given of the funding and scope of research on liquid and solid propellants; gas generators; fuel cells; MHD, thermionic, and thermoelectric generation and conversion techniques; chemistry and physical properties of propellants; batteries; underwater explosives; large plastic castings; infrared-band detection and data processing; underwater and anti-submarine technology including the effect of medium on the propagation of acoustic energy and the attenuation of propeller-created vorticity; hydrogen-cooled reactor-core heat exchangers and magnetic containment of ion plasmas; temperature, attitude, and environment of space vehicles; effects of high temperature, extreme vacuum, radiations, and the Van Allen belts on nuclear equipment; explosive technology; and design of drone systems for combat surveillance, air-to-air targetry, anti-submarine warfare, anti-missile defense training, and dissemination of toxic materials over tactical battle areas. (MCW)

25117 (AGC-2230(Vol.1)) INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAM, 1962. Volume I. (Aerojet-General Corp., Azusa, Calif. (USA); Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1962. 228p. Dep. NTIS $14.50.

Procedures used in initiating and controlling indirect research and development activities are listed. A summary is given of the funding for the technical areas for research on liquid and solid propulsion; for power conversion from thermionic, direct energy, thermoelectricity, and solar energy; chemical research on jelled propellants, NF compounds, activated chemical species, purification of water, physiological evaluation of compounds, and conversion of lunar raw materials; infrared, optical, and other sensing devices for detection, information processing, communications, and control; water propulsion systems and anti-submarine warfare capabilities; nuclear fuels and nuclear power plants for ground-based and space applications; plasma physics, superconductors, radiation shielding for space vehicles, micro-particle dynamics and irradiation in space environments, semiconductor and solid state studies for energy conversion and detection; high-strength, high-temperature structural materials for propulsion systems, missiles, and space vehicles; drone requirements, target acquisition techniques, and other aeronautics and weapons systems; properties and effects of explosives; information and techniques for man to sustain himself in space; automation and information processing; and physical characteristics of space and the planets, integration of instrumentation and vehicle with the space mission, protective and environmental control techniques for re-entry, and space instrumentation techniques. (MCW)

25118 (INIS-mf-1483) OECD NUCLEAR ENERGY AGENCY. I. Activity Report, July 1971–December 1972. (Nuclear Energy Agency, 75–Paris (France)). [nd]. 101p. (In French and English). INIS.

The report of July 71 to December 72 analyses: the present impact of nuclear energy together with the way in which nuclear energy will meet energy demands of the OECD zone in the near future; the work undertaken by the Agency on health protection together with regulations and legislation on nuclear energy matters; the promotion of nuclear energy undertaken by the Agency through the intermediate of the large common undertakings created during the preliminary period of the Agency's existence (Dragon and Halden projects, fast gas cooled reactors, isotopic generators, utilization of radioisotopes for the preservation of foods, and the direct conversion of heat into electrical energy); the work undertaken by the Agency in the field of information (specialized committees, center for compiling neutronic data, and a computer program library). (INIS)

25119 (TID/SNA-66) INDEPENDENT RESEARCH AND DEVELOPMENT PROGRAMS. Fiscal Year 1964 (1 December 1963–30 November 1964). Volume I. Program Descriptions. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jul 1963. 353p. Dep. NTIS $20.75.

Continuing and new programs and requirements of Aerojet-General Corporation are summarized and described. This volume covers: planning and control, liquid propulsion, solid propulsion, power generation and conversion, chemistry, electro-optics, underwater technology, nuclear technology, physics, materials and structures, aeronautics, explosive technology, life sciences, automation, space systems, and communications and controls. (DLC)

25120 TREATMENT OF BACKGROUND IN DETERMINING PHYSICS RESEARCH COSTS AT NUCLEAR REACTOR FACILITIES. Petrov, Yu. V. Sov. At. Energy (Engl. Transl.); 36: No. 6, 659-661(Jun 1974).

Translated from At. Energy. (USSR); 36: No. 6, 520-522(Jun 1974).

Background radiation is considered in the study of reactor flux characteristics in research reactors. The extent that background radiation can be included in research program costs is demonstrated. (MCW)

Mathematics and Computers

Refer also to abstracts 22638, 23049, and 23050.

25121 (AERE-R-7826) FORMAL REPRESENTATION OF PROTOCOLS FOR COMPUTER NETWORKS. Rusbridge, R. E.; Langsford, A. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Dec 1974. 26p. Dep. NTIS (US Sales Only) $4.50. UK £1.00.

The logical structure of communication protocols for computer networks is considered. After indicating the need for a formal representation technique for protocols, both as an aid in implementation, and as a basis for establishing logical properties of protocols, a suitable technique is presented and illustrated by examples. Some protocols from ARPA and EPSS networks are included in the discussion. The theory presented is in no sense complete and indications are given of further work, particularly with regard to automatic protocol verification and to extending it to cover hierarchical systems of protocols. (auth)

25122 (BDX-613-1223) SAMPLE SIZE TO SET SPECIFICATION LIMITS. Technological Spinoff Report. Kirkpatrick, R. L. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1975. Contract AT(29-1)-613. 18p. Dep. NTIS $4.00.

Statistical tolerance limits are used to determine specification limits to be held in the manufacture of a product characteristic. A normal distribution can be assumed with $\bar{x}$ and s as sample mean and standard deviation, respectively. One-sided statistical tolerance limits are used to set a single specification limit; either a lower, $\bar{x} - ks$, or an upper, $\bar{x} + ks$. Two-sided statistical tolerance limits are used to set double specification limits of both a lower ($\bar{x} - Ks$) and an upper ($\bar{x} + Ks$). Ordered sample values can also be used as statistical tolerance limits. These limits are called distribution-free since the assumption of normality is removed. The one-sided statistical tolerance limit is the mth smallest value for a lower limit or mth largest sample value for an upper limit. Two-sided statistical tolerance limits are the rth smallest and sth largest sample values where $m = r + s$. A recurring industrial statistical problem is to determine the sample size to use in setting these specification limits to be held in the manufacture of a product characteristic. Tables are provided for determining the sample size n such that the probability is β that the proportion $p \pm d$ is within computed statistical tolerance limits. (auth)

25123 (BNL–19491) TRANSACTION PROCESSING IN THE COMMON NODE OF A DISTRIBUTED FUNCTION LABORATORY COMPUTER SYSTEM. Stubblefield, F. W.; Dimmler, D. G. (Brookhaven National Lab., Upton, N. Y. (USA)). Dec 1974. 11p. (CONF-741213–14; CONF-741212–12). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

A computer network architecture consisting of a common node processor for managing peripherals and files and a number of private node processors for laboratory experiment control is briefly reviewed. Central to the problem of private node-common node communication is the concept of a transaction. The collection of procedures and the data structures associated with a transaction are described. The common node properties assigned to a transaction and procedures required for its complete processing are discussed. (auth)

25124 (CISE-N–166) PROGRAM FOR THE RESOLUTION OF STIFF SYSTEMS OF NON-NORMAL DIFFERENTIAL EQUATIONS. Rossi, F. (Centro Informazioni Studi Esperienze, Milan (Italy)). Mar 1974. 67p. (In Italian). Dep. NTIS (US Sales Only) $6.50.

An algorithm and the relative program are described to solve stiff problems of the form: $f(y,y',t) = 0$ with y, y', $t \in R^N$ and $t \in R$, given appropriate initial conditions. Some results are given of numerical experience with some test problems. (tr-auth)

25125 (CISE-N-170) OPTIMAL CONDITIONING OF SELF-SCALING VARIABLE METRIC ALGORITHM. Oren, S. S.; Spedicato, E. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

Variable Metric Methods are "Newton Raphson-like" algorithms for unconstrained minimization in which the inverse Hessian is replaced by an approximation, inferred from previous gradients and updated at each iteration. During the past decade various approaches were used to derive general classes of such algorithms having the common properties of being Conjugate Directions methods and having "quadratic termination." Observed differences in

actual performance of such methods motivated recent attempts to identify variable metric algorithms having additional properties that may be significant in practical situations (e.g., nonquadratic functions, inaccurate linesearch, etc.). The SSVM algorithms are such methods that among their other properties, they automatically compensate for poor scaling of the objective function. Some new theoretical results are presented identifying a subclass of SSVM algorithms that have the additional property of minimizing a sharp bound on the condition number of the inverse Hessian approximation at each iteration. Reducing this condition number is important for decreasing the roundoff error. The theoretical properties of this subclass are explored and two of its special cases are tested numerically in comparison with other SSVM algorithms. (auth)

25126 (COO-2383-0012) MULTI-DERIVATIVE NUMERICAL METHODS FOR THE SOLUTION OF STIFF ORDINARY DIFFERENTIAL EQUATIONS. Brown, R. L. Jr. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Aug 1974. 98p. (UIUCDCS-R-74-672). Dep. NTIS $8.00.

Current research in the physical sciences and engineering has greatly enhanced the importance of computer programs for the numerical solution of systems of ordinary differential equations. Recent developments have concentrated on the solution of systems characterized as stiff for which the requirement of numerical stability can cause some integration methods to use a smaller stepsize than the control of the local truncation error requires. The stability and convergence of linear multi-step multi-derivative formulas were investigated since it has been shown that linear multi-step formulas of order greater than two cannot be A-stable, a useful attribute for formulas used to integrate stiff systems. It was shown that when a stable and consistent linear k-step s-derivative formula implemented in an iterated corrector method is applied to a system satisfying certain continuity requirements, the solution is convergent. A set of 11 multi-derivative multi-step formulas, all A-stable and of orders 1 through 11, were found and implemented in a variable stepsize, variable order method as a FORTRAN program called D4. Tests of D4 on a set of stiff problems show it compares favorably with another stiff integrator. (auth)

25127 (COO-2383-0015) QUARTERLY TECHNICAL PROGRESS REPORT, JULY, AUGUST, SEPTEMBER 1974. (Illinois Univ., Urbana (USA). Dept. of Computer Science). [nd]. 182p. (UIUCDCS-QPR-74-3). Dep. NTIS $12.25.

A summary of the Navy hardware research involving stochastic processing methods and molecular stochastics is given. Specific hardware research includes progress on an adaptive robot that learns from visual clues; an aid to the blind; theatre lighting control computer; identifying certain plane figures regardless of orientation; an array computer; and an automatic hardware cardiac monitor for detecting irregularities in an EKG. Progress on software systems research is reported on numerical processes, graphic support packages, user oriented software, and satellite processor software and hardware. Switching theory and logical design progress is reported. Improved designs for computer and software systems are being studied in parallel and pipeline processors small primary memories, effective use of rotating memories, and user languages for problems including typical FORTRAN type calculations, simulation languages, and file processing problems. Aspects of combinatorial computing; theory of digital computer arithmetic; ACSES, the automated computer science education system on PLATO; machine perception and intelligence; iterative solution of symmetric and nonsymmetric systems with dynamic estimation of parameters; and the MESH research project progress are summarized. (MCW)

25128 (IS-3496) OS910, THE SDS-910 OPERATING SYSTEM. Lucido, A. P.; Moon, L. C. (Ames Lab., Iowa (USA)). Jan 1975. Contract W-7405-eng-82. 87p. Dep. NTIS $7.50.

The OS910 operating system for the SDS-910 computer is discussed in detail. The operating systems communications with the PDP-15 computer are enumerated. Examples are given on how user programs are to communicate with the operating system and their experiment. (auth)

25129 (KFK-2072) INTERACTIVE GRAPHICAL SYSTEMS: GENERAL CHARACTERISTICS AND PERFORMANCE CRITERIA OF SOME REPRESENTATIVE SYSTEMS. Grauer, H.; Merkel, R. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Datenverarbeitung in der Technik). Oct 1974. 60p. (In German). Dep. NTIS (US Sales Only) $6.00.

The technology of the components of modern interactive graphical systems is examined and the combination of these components to systems of different efficiency is shown. After then the results of an investigation of the hardware and software performance characteristics of 10 interactive graphical systems, which are representative for the European and American market, are given. (auth)

25130 (RISO-M-1756) SOME ASPECTS OF THE APPLICATION OF DIGITAL TECHNIQUES ON STOCHASTIC TIME SERIES. Kristensen, L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1974. 36p. Dep. NTIS (US Sales Only) $5.00.

When a stochastic signal x(t) which is a continuous function of time is sampled digitally with a certain repetition frequency Δt, an analysis shows that the recorded signal y(t) has more variance than x(t). This is due to the finite resolution in the determination of y(t). It is shown that the extra variance is equal to $D^2/12$ and that the condition that this "digital noise" is white is that $(\Delta t\sigma)/(\lambda D) > 1$, where σ is the rms of x(t) and λ is its Taylor microscale. The effect of aliasing is demonstrated when the spectrum is a power law and in a special case where the spectrum has a maximum. Finally, the effect of extending the record with zeros is given some consideration. (auth)

25131 (SLA-74-0209) 9-DIGIT INSTRUMENT MULTIPLEXED COMPUTER INTERFACE. Woodward, M. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1975. Contract AT(29-1)-789. 44p. Dep. NTIS $5.25.

Described are software and hardware techniques for the interfacing of up to eight measuring instruments which provide digital output capabilities of up to nine binary coded decimal digits. (DLC)

25132 (TID-26615) CAMAC: THE DEFINITION OF IML, A LANGUAGE FOR USE IN CAMAC SYSTEMS. (USAEC, Washington, D. C.). 1974. 40p. Dep. NTIS $4.00. GPO $0.85.

IML is a language used to express the operations described in the CAMAC hardware specifications, and their interaction with a computer system. IML statements link CAMAC structures and modes of operation to data structures and real-time features in the computer system. This definition is a guide for those implementing languages and operating systems who wish to make CAMAC input/output available to users. Features are included which support the CAMAC Branch Highway and the CAMAC Serial Highway. The language is defined semantically—the syntax used to express IML depends on the environment. The macro syntax IML-M1 is defined in an appendix. (auth)

25133 (UCID-16605) USER'S MANUAL FOR THE OIL CODES. Cunningham, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Oct 1974. Contract W-7405-eng-48. 71p. Dep. NTIS $6.75.

Since the OIL family of codes is now being used extensively, it has become necessary to formalize information for the various users and to update information on the newer codes as development work is done on them. The manual provides instructions for setting up problems on the mine-material version of the RADOIL code. It will be revised and expanded to include the DORF code and other codes in the OIL family as appropriate. (auth)

25134 (UCID-30100) TRIX: AN INTERACTIVE, INTERPRETIVE LANGUAGE FOR MANIPULATING STRINGS OF CHARACTERS. Moll, H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Nov 1974. Contract W-7405-eng-48. 50p. Dep. NTIS $5.50.

TRIX is a language for manipulating strings of characters. It consists of functions and a syntax for assembling these functions into named procedures called macros. A program written for the TRIX interpreter is called a dialect. The TRIX user writes a dialect (program) by writing a series of macros as a disk file, and then reads-in (interprets) the dialect and executes the macros to carry out operations on a text file. Dialects run under TRIX are used for text editing, where text can be source code (e.g., a Fortran disk file) or English-language text. The basic TRIX functions, the TRIX syntax, and brief examples of macros, showing applications to text-editing procedures are described. TRIX is an executable controllee (written in assembly language) available on the CDC 6600 and 7600 computers of the Livermore time-sharing system. (auth)

25135 (UCRL-76268) STAR TREK. Kishi, T.; Rudy, T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Dec 1974. 4p. (CONF-750206-1). Dep. NTIS $4.00.

From CONPON conference; San Francisco, California, USA (25 Feb 1975).

The transition from the conventional sequential computer system to the advanced parallel and vector processor systems is considered. The vector and array processing concepts of the STAR and the ILLIAC IV are discussed as applied to large scientific problems. (auth)

25136 (UCRL-76434) ANALYTIC TOOLS THAT AID IN THE TEST AND EVALUATION OF OPERATING SYSTEM SECURITY.

Chin, J. S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1975. 13p. Dep. NTIS $4.00.

It is becoming increasingly apparent that the threat of compromise to the security of computers as data storage media can pose significant dangers in both the governmental and non-governmental areas. In its continuing effort to further research into this problem ARPA is funding the RISOS project (for Research in Secured Operating Systems) at the LLL to investigate ways in which the security of operating systems can be tested, evaluated, and improved. RISOS is developing a systematic approach to the investigation of operating systems. Due to the volume of code involved in such investigations, this project has designed and implemented programs to aid analysis by performing such tasks as highlighting problem areas, removing extraneous lines from the assembled source listings, and providing ready access to the listings. These programs, called tools, operate on data bases made from the source listings of operating systems under test. A number of these tools, their capabilities, and their characteristics are described. (auth)

25137 (UCRL-76464) FOCAL-S, A MODIFIED FOCAL IN A MULTITASK ENVIRONMENT. Lockhart, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 11p. (CONF-741001-44). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

FOCAL-S is an integration of FOCAL-69 with 8 K, MOD V, and FOUR WORD overlays into a system of equipment calls and device handlers for data acquisition and instrument control. Data and status information is passed to FOCAL where it can be operated upon by the powerful instruction set of the high level language. A software interrupt structure is incorporated to allow device status to control FOCAL text execution. Generalized software is provided for the processing of BCD, analog, and mixed data sources, utilizing available FOCAL and floating package internal routines. Several device calls are illustrated with the intent of showing how other instruments with similar features could be incorporated into the software. (auth)

25138 (UCRL-76465) PLAN FOR COMPUTER AIDS TO DIGITAL SYSTEM DESIGN. Loomis, H. H. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 8p. (CONF-741001-45). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The development of a comprehensive system of computer aids to the design of digital systems will provide the following capabilities to aid the designer: translation of a high-level description of the digital system (in a register transfer language like CDL) into the appropriate interconnection of logic elements such as gates, flip-flops, full adders, etc.; a functional simulator of systems described in the same high-level language; a data entry program permitting the inputting of the logic specification and sufficient schematic information to permit the production of general logic diagrams; and a logic-element-level design program that accepts a description of a system as an interconnection of logic elements and produces the placement of the logical cards and the instructions for the wire-wrap machine to interconnect the back-panel. This program also verifies the design with respect to loading rules and maximum signal path length and produces appropriate design documentation. A schematic generator produces finished schematic diagrams of systems specified. A description is given of the system and it is shown how each component program will contribute to the improved accuracy and reduced cost of the design process for few-of-a-kind, moderately complex digital systems. Possible alternatives to the above program will be discussed. (auth)

Miscellaneous

25139 (GKSS-74/E/1) SCIENTIFIC-TECHNICAL REPORTS OF THE GKSS IN 1973. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1974. 41p. (In German). INIS.

The review contains information on titles and authors of all GKSS reports published in the year 1973. The external reports, as long as reprints of journal articles are not concerned, are reproduced in the appendix with the corresponding abstracts and/or bibliographic data. (GE)

25140 (ORNL-4927) WATER MOVEMENT THROUGH SATURATED-UNSATURATED POROUS MEDIA: A FINITE-ELEMENT GALERKIN MODEL. Reeves, M.; Duguid, J. O. (Oak Ridge National Lab., Tenn. (USA)). Feb 1975. Contract W-7405-eng-26. 236p. Dep. NTIS $7.60.

A two-dimensional transient model for flow through saturated-unsaturated porous media has been developed. This model numerically solves the governing partial differential equations, which are highly nonlinear. The model code uses quadrilateral finite elements for the geometrical assembly, bilinear Galerkin interpolation for the spatial integration, and Gaussian elimination for the solution of the resulting matrix equations. In addition to the usual constant-flux and constant-head boundary conditions, the code is capable of applying pressure-dependent boundary conditions at the ground surface. Thus, infiltration into or seepage from this surface may be simulated. Each element may be assigned different material properties that allow the investigation of layered geologic formations. The formulation of the governing equations and the computer implementation are presented. The report is intended for use as a complete user's manual and contains a listing of the computer code (in FORTRAN) along with both input and output data for two example problems. The results of a computer simulation are compared with experimental data obtained by J. D. Hewlett and A. R. Hibbert from an inclined soil slab at Coweeta Hydrologic Laboratory in North Carolina. The computer model gives good results in this simulation. The Galerkin finite-element method is found to be superior to the finite-difference method used by previous investigators. Here a comparison with a finite-difference model developed by R. A. Freeze is made. By exploiting the flexibility of the finite-element geometrical discretization, the user may easily reduce computer running time by a factor of two. (auth)

25141 (UCRL-76459) HEADWAY CONTROL THEORY OF VEHICULAR TRAFFIC. Collins, J. C.; Epps, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 10p. (CONF-741001-41). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

A multi-lane theory of vehicular traffic is described. The basic tenet of the theory is that the driver's behavior is based upon whether or not he is close enough to the car ahead to interact with it. A driver programs his behavior upon catching up to a slower moving car by either passing this car or following it. When the interaction begins, passing is first considered. If the conditions for passing are not satisfied, the driver will elect to follow. He does so by attempting to maintain a constant time headway between himself and the car ahead. Acceleration or deceleration is initiated as demanded by the instant value of the headway and the velocity differential between himself and the car ahead. A behavioral algorithm for the driver is written in a form suitable for computer analysis. The car-following algorithm and the passing algorithm are implemented and examined, and the feasibility of impressing an external control scheme upon the vehicular model is also examined. (auth)

25142 JAHRESBERICHT 1973. (Annual Report 1973). Braunschweig, F. R. Germany; PTB (Feb 1974). 224p. (In German).

The Annual Report includes information about the organizational and administrative development of the Bundesanstalt as well as the scientific accomplishments in 1973, test and approval of measuring instruments and materials and the participation in national and international committees. The second part is comprised of short reports on published and non-published work finished during the year or results from continuing projects. (GE)

Chemistry

25143 (AED-CONF-74-440-006) INTERACTION OF RADICALS WITH EXCITED STATES OF SOME BIOMOLECULES. Neubacher, H.; Walla, W. (Giessen Univ. (F. R. Germany). Inst. fuer Biophysik). 1974. 5p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

Important intermediate products in photochemical and photobiological reactions are often the triplet states of the molecules involved. The population density of these excited states are determined by varied effects of the close neighborhood, as for example, by the presence of heavy atoms or paramagnetic ions. In the investigation of biphotonic photosensitization reactions which occur over triplet-triplet absorptions, it can be seen that even formed radicals quench the triplet state. In order to explain the mechanism of this interaction, influences on various inner molecular transitions must be considered. A kinetic analysis is carried out, the result of which limits the interaction possibilities. The kinetic model leads to conclusions with the occurrence of photodamages which are confirmed by means of simple bimolecular systems. (GE)

25144 (AERE-R-7807) PREPARATION OF PEROXYACETYL NITRATE (PAN) AND ITS DETERMINATION IN THE ATMOSPHERE. Sandalls, F. J.; Penkett, S. A.; Jones, B. M. R. (UKAEA Research Group, Harwell. Atomic Energy Research

Establishment). Nov 1974. 23p. Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

The important air pollutant peroxyacetyl nitrate (PAN) has been prepared in the laboratory in a pure form and its concentration in nitrogen determined by both a chemical and a physical technique. A standardized mixture of PAN in nitrogen was then used to calibrate a gas chromatograph equipped with both a flame ionization detector and an electron capture detector. A number of measurements of PAN in the atmosphere were made. (auth)

25145 (CEA-R-4557) STUDY OF MOLECULAR LIQUIDS USING NUCLEAR MAGNETIC RESONANCE. Alexandre, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Chimie). Jan 1975. 104p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis. Submitted to Paris Univ., Orsay, France.

A study of molecular liquids, mainly with NMR is presented. In the first part chlorine fluorides ClF_3 and ClF_5 have been studied. Nuclear relaxation times of chlorine and fluorine allow determination of reorientational correlation time and angular correlation time. The comparison between these two times shows that reorientations must occur by a large angle jump process rather than a diffusion process. In a second part, micellar solutions are studied. It is shown that the inside of a micelle must be regarded as fluid. When solutions are concentrated, micelles become oblong, the length being about 800 Å. In the last part miscellaneous information is obtained, such as chlorine–fluorine scalar coupling in ClF_3, ClF_5 and $ClOF_3$, or the chemical shift between inequivalent fluorines of $ClOF_3$. Expressions giving transverse relaxation time in systems with coupled spins are carried out, and the agreement with experience, in liquid alkanes, is satisfactory. (tr-auth)

25146 (CEA-R-4628) STATISTICAL STUDY OF ERRORS ASSOCIATED WITH QUANTITATIVE GAS CHROMATOGRAPHY ANALYSIS ACCURACY OPTIMIZATION. Dupuis, M. C.; Charrier, G.; Lutz, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Feb 1975. 39p. (In French). Dep. NTIS (US Sales Only) $5.00.

The work synthesizes several years experience in the field of gaseous mixtures quantitative chromatographic analysis. The quest for a proper estimate of result affecting errors, associated to the care for optimizing accuracy has led to the use of very accurate measurement apparatus as well as appropriate data acquisition techniques to a statistical analysis of the observed values distribution from sets of diversified results. An analysis procedure was adopted that consists of comparing alternatively the unknown sample to the calibration mixture. This method achieves the maximum freedom from fluctuations and slow devices drifts. The measured concentrations ratio of a given component between two mixtures is a random variable, the distribution of which is rather normal; its variation coefficient (relative standard deviation) ranges from 10^{-3} to some 10^{-2} according to the considered concentration range. Other systematic sources of error must be cancelled or corrected or otherwise minimized (particularly with respect to the uncertainty on the standard mixture composition). Examples of analyses carried out on atmospheric air emphasize the overall precision. Under experimental conditions, the confidence interval related to the mean measured concentration is (at a 95% probability level) estimated to: 0.2% for oxygen (concentration $\simeq 21\%$), 3% for carbon dioxide (concentration $\simeq 320 \cdot 10^{-6}$), 3% for neon (concentration $\simeq 18 \cdot 10^{-6}$). (tr-auth)

25147 (LBL-3356) SPIN EXCHANGE IN BIRADICALS. Metzner, E. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-eng-48. 187p. Dep. NTIS $12.50.

Thesis.

A series of rigid nitroxyl biradicals was synthesized and their spin exchange properties studied. In general no relation between the distance or number of bonds separating the free radical units of a biradical and the exchange magnitude could be established. This seems to rule out the use of the exchange properties of biradicals as quantitative geometrical probes. The effect of solvent and temperature on the exchange energy of these biradicals was also studied. The exchange energy is very sensitive to solvent and in most cases correlated with polarity of the solvent. The effect of temperature on the exchange varied with solvent and the connecting structure of the biradical. Small linear changes in the exchange energy with temperature are thought to be due to changes in solvation. Larger changes that result in the modulation of the exchange are associated with conformational changes in the molecule. With the data obtained from these biradicals an attempt was made to establish the mechanism of spin exchange. Both the direct exchange and indirect exchange mechanism could be rationalized; however, the indirect mechanism provided a better explanation for most observations. The spin exchange properties of two series of flexible biradicals were also studied and in general proved to be similar to the rigid biradicals. Spin exchange in these molecules could also occur by an indirect mechanism; however, direct exchange in conformations which bring the nitroxyl groups into close proximity is also possible. The results obtained suggest that the spin exchange property of biradicals may yield valuable information about the environment within a molecular structure. Applications to the study of membrane and membrane models as well as the study of enzyme and other polymers are suggested. (auth)

25148 (ORNL-tr-2884(DRAFT)) THERMOELECTRIC ENERGY OF AgCl, $NiCl_2$, $FeCl_2$, AND $CrCl_2$ IN MOLTEN LiCl.KCl EUTECTIC. Jarny, P. nd. Translated by M. Gerrard, Oak Ridge National Lab., TN, from a French paper. (CONF-740358-1). 18p. Dep. NTIS $4.00.

The importance of the thermoelectric energy in predicting corrosion phenomena in molten salts in the presence of thermal gradients was shown. Measurements of this property were made in the systems Ag/Ag^+, Ni/Ni^{2+}, Fe/Fe^{2+}, and Cr/Cr^{2+} in molten eutectic chlorides, LiCl · KCl. In dilute solution the thermoelectric energy satisfies the relation $d\varphi/dT \simeq 2{,}303\,(R/zF)\log X + B$. The form of this relation was shown to be that for behavior of ideal solutions or at low concentrations. For a given MCl_z concentration (M = Ag, Ni, Fe, Cr) the emf of the thermopile was measured as a function of the temperature difference. The slope, $d\varphi/dT$, of the line obtained for each concentration gives the value of the thermoelectric energy. (MCW)

25149 (RCN-221) SORPTION OF ZINC AND CADMIUM FROM FRESH WATER AND SEAWATER. van der Weijden, C. H. (Stichting Reactor Centrum Nederland, Petten). Jan 1975. 40p. Dep. NTIS (US Sales Only) $5.00.

Adsorption isotherms of Zn^{2+} and Cd^{2+} from artificial seawater by some minerals and Fe/Mn-oxides were measured at pH values of 7 and 8 and different ionic strengths. It appears that Zn^{2+} is more strongly adsorbed and that the desorption of Cd^{2+} from terrestrial sediments is about three times as high as that of Zn^{2+}, explaining the appreciable difference between the average residence times of Zn^{2+} and Cd^{2+} in the oceans. (DLC)

25150 (TRG-Report-2548(D)) IMPROVED GRAPHICAL METHODS FOR THE SEPARATION OF CRYSTALLITE SIZE AND LATTICE STRAIN IN X-RAY-DIFFRACTION ANALYSIS. Allan, C. G. (UKAEA Reactor Group, Dounreay. Dounreay Experimental Reactor Establishment). Sep 1974. 39p. Dep. NTIS (US Sales Only) $5.00. UK HMSO £1.00.

The broadening of x-ray diffraction peaks can be interpreted graphically using four simple equations. These apply to the real situation of Cauchy crystallite size broadening function and intermediate or Gaussian strain broadening function. The effects of the approximation errors in the derivation of the equations are calculated for the entire range of applicability of the equations. Errors introduced in the correction of the experimental peak breadth for doublet overlap and instrumental effects are considerably reduced when the profile functions fitting the peaks are known. A practical procedure is given and the maximum correction errors are calculated. Overall errors in the crystallite size and strain results are considerably less than 10% when the strain profile function is identified. When the strain profile function lies between Intermediate and Gaussian, or when the profile function cannot be identified, the overall errors will be less than 15%. The graphical methods are not applicable when significant densities of stacking faults are present. (auth)

25151 VIBRATIONAL SPECTROSCOPIC STUDIES ON μ-OXO AND μ-NITRIDO-COMPLEXES OF RUTHENIUM AND RHENIUM. Moumen, M. (Muenster Univ. (F. R. Germany). Fachbereich Chemie). 28 May 1973. 156p. (In German). INIS.

Available from the library of the Muenster Univ.

The molecular geometry and structural parameters, magnetic properties, vibrational spectroscopic studies, a normal coordinate analysis, the symmetry of $M_2OX_{10}^{-}$ and $M_2NX_8(H_2O)_2^{-}$ (M = Ru, Re; X = Cl^-, Br^-), the number of fundamental vibrations per class, tables of frequencies, the performance of the calculations, a discussion of the assignment and distribution of the potential energy, the experiments and the registration of the spectra are described. (GE)

Life Sciences

25152 (UCRL-76046(Rev.1)) SIMULATING THE DYNAMICS AND STRUCTURE OF POPULATIONS. Ewing, B.; Rauch, P.; Barbieri, J. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1974. 61p. (CONF-750101-2). Dep. NTIS $6.25.

From 3rd annual integrated pest management modellers conference; Berkeley, California, USA (Jan 1975).

Using a computer, it is possible to create a simulator which mimics the structure and dynamics of a biological population.

The dynamics of the simulation are provided by the nonhomogeneous Poisson process. (DLC)

Materials

25153 (BAM-J-1972) ANNUAL REPORT 1972 OF THE BUNDESANSTALT FUER MATERIALPRUEFUNG (BAM) BERLIN. (Bundesanstalt fuer Materialpruefung, Berlin (F.R. Germany)). Aug 1973. 228p. (In German). INIS.

Available from BAM.

This 1972 Annual Report of the BAM explains the organizational structure of the establishment and gives some details of a more general nature. It furthermore contains the reports of the various departments such as Metals and Metal Structures, Civil Engineering, Organic Substances, Chemical Safety Engineering, Special Fields in Materials Testing, and Research on Processes and Procedures independent of Materials Properties; these reports are supplemented by news about the activities of the president and by general statistical data as well as a list of published work. (GE)

25154 (CEA-CONF-2753) NOVEL P-MOS EIGHT CHANNELS MONOLITHIC INSTRUMENTATION AMPLIFIER AND SIGNAL-PROCESSING CIRCUIT. Borel, J.; Merckel, G.; Meunier, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1974. 8p. (CONF-740241-2). Dep. NTIS (US Sales Only) $4.00.

From international solid state circuits conference; Philadelphia, Pennsylvania, USA (13 Feb 1974).

The fabrication of an 8-channel integrated circuit is described. Each channel consists of a fast low-level amplifier, a trigger, a stable delay, a memory, and control logic. Results of the study on the novel P-MOS instrumentation are given and also measurements of channel performances within the LSI are given. (MCW)

25155 (CEA-CONF-2820) ATOMIC TRANSPORT PROPERTIES OF THE LIQUID EUTECTIC ALLOY Ag-Ge. Potard, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 5 Dec 1973. 11p. (In French). (CONF-740310-2). Dep. NTIS (US Sales Only) $4.00.

From 4th international conference on crystal growth; Tokyo, Japan (24 Mar 1974).

The knowledge of the chemical diffusion process in a eutectic liquid close to a moving solid-liquid interface is essential in understanding the solid structure formation. Measurements were made of the two self-diffusion coefficients in a Ag-Ge eutectic alloy from 800 to 658°C (T_E + 7°C). Chemical diffusion coefficients were then calculated using Darken relationship. The latter was previously experimentally verified. All these coefficients follow Arrhenius type relationship in the explored temperature region. (tr-auth)

25156 (CEA-R-4590) STRUCTURE FACTOR METHOD IN THE CALCULATION OF POINT DEFECT RESISTIVITIES. Nguyen Van Doan; Feit, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Jan 1975. 43p. (In French). Dep. NTIS (US Sales Only) $5.25.

According to the pseudo-potential theory, the excess resistivity of point defects can be calculated from their structure factor. The calculation presents two important advantages in comparison with the classical methods. It can take into account the effects of the lattice relaxation around the defect and the effects of the band structure on the excess resistivity. In order to illustrate these two points, the method was used to calculate the excess resistivity of vacancies, interstitials, and activated complexes (i.e. two vacancies at nearest neighbor positions and an ion at the saddle point). The results of these calculations are compared to the experimental data of the literature. On the other hand, they show the important effect of the band structure on the excess resistivity of vacancies in aluminium and the large contribution of the lattice relaxation on the excess resistivity of interstitials and activated complexes in copper. (tr-auth)

25157 (COO-1198-1115) EFFECT OF HETEROVALENT IMPURITIES CO-DIFFUSING WITH MONOVALENT TRACERS IN IONIC CRYSTALS. Mitchell, J. L. (Illinois Univ., Urbana (USA)). Oct 1974. Contract AT(11-1)-1198. 154p. Dep. NTIS $10.75.

Thesis.

Tracer diffusion measurements were made for ^{45}Ca and ^{22}Na co-diffusing into pure NaCl as a function of temperature, initial calcium concentration, and diffusion anneal time. The measured penetration profiles deviate markedly from the Gaussian dependence expected for diffusion from a thin source. The curvature is caused by each divalent Ca ion introducing an extra, extrinsic, vacancy into the diffusion zone in order to maintain charge neutrality. In such cases, the limiting slope was shown not to be a valid measure of the tracer diffusivity. Computer fits were generated by a model that corrects for the effect and is found to give excellent agreement with the data except for the most extreme cases. The model can find the initial concentration of the impurity and the diffusivity of the impurity within a factor of two from the penetration profile for the monovalent tracer. The effect enters to first order into the measurement of the isotope effect in ionic crystals and can result in major errors in the measured isotope effect for even small deviations from a Gaussian profile. The diffusion coefficients for ^{22}Na diffusing in NaCl over the temperature range of 575 to 775°C are given by $D_{Na} = 73 \exp(-2.04 \pm .02$ eV/kT) and for ^{45}Ca: $D_{Ca} = .23 \exp(-1.61 \pm .03$ eV/kT). (auth)

25158 (COO-3435-19) OPTICALLY DETECTED MAGNETIC RESONANCE (ODMR) SPECTROSCOPY OF THE LOWEST TRIPLET STATES OF BENZOPHENONE AND HALOGENATED BENZOPHENONES. Mucha, J. A. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). Dec 1974. 195p. Dep. NTIS $12.75.

Thesis.

Measurements are reported of the complete angular dependence of the optically detected magnetic resonance (ODMR) spectra of 4,4'-disubstituted-benzophenones (4,4'-DXBP; X = H, F, Cl, Br) in 4,4'-dibromodiphenylether (DDE) and X-traps in neat 4,4'-dichlorobenzophenone at liquid helium temperatures. The results are used to calculate the principal values of the D and g tensors of the lowest triplet states. The temperature dependence of the ODMR spectra indicate the absolute zero-field (ZF) level ordering to be Z > O > Y > X. Carbon-13 hyperfine, fluorine hyperfine, and bromine hyperfine and quadrupole were observed and yield estimates of the π spin densities on the carbonyl carbon ($\rho^{\pi} \sim 0.2$) and the 4,4' ring positions of the benzene rings ($\rho^{\pi} \sim 0.1$). Experimental studies of level anticrossing and cross-relaxation effects on the phosphorescence and ODMR spectra of benzophenones in DDE are described and interpreted. A novel method of determining the magnitude of the perturbation giving rise to the level anticrossing is presented. It is concluded that (1) the orbital symmetry of the lowest triplet state of benzophenones is A, (2) the ZF schemes are significantly perturbed by second-order spin-orbit coupling with higher triplet states, (3) ring conformations and substituents influence the ZF splittings, and (4) a significant amount of electron spin is delocalized throughout the molecule. (auth)

25159 (IAE-2310) METAL-NON-METAL TRANSITION IN DENSE METAL VAPOR. Kikoin, I. K.; Senchenkov, A. P.; Naurzakov, S. P.; Gel'man, E. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 24p. (In Russian). INIS.

A review is presented of studies on metal-nonmetal transitions in Hg and Cs. The results of new measurements of the equation of state of Hg are reported. Some questions concerning the properties of metal-nonmetal transitions in different metals are discussed. (tr-auth)

25160 (IS-T-653) VARIATION OF THE NEEL TEMPERATURE AS A FUNCTION OF SOLUTE CONCENTRATION FOR SEVERAL ANTIFERROMAGNETIC ALLOYS OF ALPHA-MANGANESE. Williams, W. Jr. (Ames Lab., Iowa (USA)). Nov 1974. Contract W-7405-eng-82. 169p. Dep. NTIS $11.50.

Thesis.

The variation of the Neel temperature (T_N) of several dilute antiferromagnetic (AFM) alloys of Mn was studied by electrical resistivity measurements. In the experiment, the anomalous behavior of the electrical resistivity at the AFM ordering temperature (T_N) was used to determine the Neel temperatures. This appearance of a well-defined minimum in the resistivity versus temperature curve provides values of T_N to within ±2 K. Measurements were taken on several binary and ternary alloys. The alloys studied were Mn-Fe, Mn-Co, Mn-Ni, Mn-Ti, Mn-Os, Mn-Rh, Mn-Ir, Mn-Fe-Cr, and Mn-Fe-Ni. The results show a strong and systematic dependence on the number of d-electrons of the impurity element. Elements with more d-electrons than Mn raise T_N, while those with less d-electrons depress T_N. The variation of T_N with atomic percent solute is linear for the nearest-neighbor impurities and tends toward a higher power for next-nearest-neighbor impurities. This trend is observed for the first long period and in part for the second and third periods. (auth)

25161 (IS-T-655) ABSOLUTE THERMAL EXPANSION OF COPPER AND ALUMINUM BETWEEN 5 K AND 330 K. Kroeger, F. R. Jr. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). Nov 1974. Contract W-7405-eng-82. 125p. Dep. NTIS $9.25.

Thesis.

The linear thermal expansion coefficients α of copper and aluminum were measured in an absolute sense between 5°K and 330°K. The sample was supported by glass spacers in a copper

cell. Sample length changes were detected as changes in the capacitances of the two three-terminal, parallel-plate capacitors between the sample and cell ends. A three-terminal, ratio-transformer, ac capacitance bridge was used with a phase-sensitive detector to measure the nominally 10 pF capacitances to a precision of 10^{-7} pF; changes of 0.02 Å in the 10-cm sample length could be detected. The $\alpha(T)$ data were fit with fifth order polynomials in four overlapping temperature ranges; the sets of fit coefficients, tabulations of smoothed values, and deviation plots of the data from the smoothed fits are given in the text. The absolute accuracy of the smoothed results ranges from ±0.1% above 50°K to ±0.5% near 20°K and ±1% at 10°K, reflecting the scatter in the data. The results of other measurements on copper and aluminum during the past 20 years also are compared to the present results via deviation plots. (auth)

25162 (JUL-1068-FF) STORED ENERGY OF STRAIN-DEFORMED COPPER MONOCRYSTALS OF DIFFERENT ORIENTATION IN THE REGION II AND III OF THE SOLIDIFICATION CURVE. Gottstein, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung; Technische Hochschule Aachen (F.R. Germany)). May 1974. 79p. (In German). INIS.

Highly pure copper monocrystals of six different orientations and copper polycrystals with a grain size of 0.35 mm were strain-deformed at 78 K. The heat energy which is set free in the temperature region from 40°C to 400°C was determined in a recovery calorimeter (electron beam calorimeter). In all samples, only a maximum of the energy release was observed in the temperature range investigated. As all samples were finally recrystallized, the measured value of the stored energy is identical to the heat of recrystallization. The measured values of the stored energy are discussed depending on the shearing strain (yield stress) and compared with the results of crystals deformed at high temperatures, depending on the temperature of deformation. The stored energy is for crystals of different orientation, reciprocal to the gradient of the solidification curve in the region II, Θ_{II}. The product $E_s \times \Theta_{II}$ is thus dependent on the orientation. At higher temperatures of deformation, the proportionality between the stored energy and the square of the yield stress is only valid at small strains. At higher strains, the stored energy of the monocrystal deformed at higher temperatures increases more strongly with the square of the yield stress than the crystals deformed at low temperature. With the present results it is possible to calculate the stored energy for strain-deformed copper monocrystals of any orientation from the solidification curve. (GE)

25163 (LA-tr-7437) COMPARATIVE EXPLOSIVE PROPERTIES OF A NITROPOLYSTYRENE AND SOME DINITROTOLUENES. Medard, L. Translated from Mem. Poudres; 34: 99-105 (1952). 11p. Dep. NTIS $4.00.

From experiments on shock sensitivity, detonation characteristics and specific usages conducted on a sample of dinitropolystyrene (13.9% nitrogen), it is apparent that, from the viewpoint of explosive properties, this substance is comparable to crystallized dinitrotoluene. The author also examines how nitropolystyrene can be applied to the area of explosives using either its dispersion in explosive oils, from which plastic explosives can be made, or its very low density, which can lead to the type of mining explosive called light explosives. (auth)

25164 (LBL-3172) COMPUTER SIMULATION OF SPUTTERING. Mundkur, P. V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 98p. Dep. NTIS $8.00.

Thesis.

The dependence of the sputtering ratio on the potential function describing the interactions between an incident neon ion and copper target atoms was studied with the help of a computer simulation model of sputtering. The results of this simulation indicate that the variation of the sputtering ratio with incident ion energy is dominated by the nature of the Ne^+-Cu interatomic potential function. Data on the sputtering of single crystal copper was used to extract information about the potential function for Cu-Cu interactions in the energy regions over which the sputtering data was available. The Ne^+-Cu and Cu-Cu interaction potentials were so derived that the variation of the sputtering ratio for the three Cu crystal faces (111), (100), and (110) matched experimental data. In addition, the Cu-Cu interatomic potential was adjusted so that repulsive force contributions matched the experimental elastic moduli of copper. The derived potentials differed significantly from the Gibson-2 potential that had been used for Cu-Cu interactions in all previous sputter simulations. A computer simulation model was applied to calculate the sputter ratio of (100) Cu by 10 keV Ne^+ ions at incidence angles from 20° to 50° from the surface normal in the (110) plane. The calculation results show maxima and minima in the sputter ratio at incident angles in relative agreement with the experimental data of Onderdelinden. A submaximum in sputter yield was obtained near the 45° minimum. The peak was larger for Ne^+ sputtering than for Ar^+ sputtering of copper. (auth)

25165 (LBL-3175) ELECTRODEPOSITION AROUND PROTRUDING SURFACE IMPERFECTIONS IN TURBULENT FLOW. Carlson, E. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1975. Contract W-7405-eng-48. 81p. Dep. NTIS $7.25.

Thesis.

Cathodic deposition of copper around small cylindrical and spherical protrusions located on the cathode surface in a channel with rectangular cross-section (D_h = 4 cm) at Reynolds numbers up to 50,000 was studied as a function of the protrusion height and diameter and of the related parameters of flow rate, overpotential and fraction of the limiting current. The distinctive wake region, caused by perturbations in the flow induced by the protrusion, was characterized using scanning electron microscope, optical microscopes and macrophotography. These techniques and quantitative measurement of the amount of deposit in- and outside the wake revealed: the current density inside the wake was approximately twice as high and the porosity four times larger than those outside; the wake was not reflected in the deposit when the height of the protrusion was below 0.1 mm and when $i/i_L \leq 0.9$; and at the limiting current large powder clusters formed in the wake in contrast to the uniform powdery growth outside the wake. (auth)

25166 (LBL-3183) PERFLUOROAROMATIC CATIONS AND RELATED STUDIES. Richardson, T. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 121p. Dep. NTIS $9.25.

Thesis.

The radical cations $C_6F_6^+$ and $C_{10}F_8^+$ were synthesized in bulk solids for the first time through the reactions of hexafluorobenzene with dioxygenyl salts and of $C_6F_6^+$ with octafluoronaphthalene. The novel compounds thus prepared were characterized by a number of physical and spectroscopic techniques, and the crystal structure of $C_6F_6^+AsF_6^-$ was determined from X-ray powder diffraction data. Adducts formed by the interaction of chlorine with dioxygenyl salts were investigated and preliminary results are presented. Formation of these adducts is partly reversible, and does not appear to involve substantial oxidation of chlorine. These are tentatively formulated as salts of the previously unreported cation, $Cl_2O_2^+$. Studies of the oxidizing power of dioxygenyl salts and the oxidizing and fluorinating properties of iridium hexafluoride were carried out with the aim of oxidizing inorganic anions to their corresponding neutral radicals. These experiments were unsuccessful, but give insight into the problems involved, and hold out some hope for future success. The xenon (II) salts $Xe_2F_3^+RuF_6^-$ and $Xe_2F_3^+IrF_6^-$ were hydrolysed to produce RuO_4 and an as yet unidentified volatile iridium compound, possibly IrO_4. The presence of $ClO_2^+IrF_6^-$ in preparations of $ClF_2^+IrF_6^-$ were explained and a crystal structure thought to be that of the ClF_2^+ salt was re-interpreted in the light of these findings. (auth)

25167 (LBL-3503) EFFECT OF RETAINED AUSTENITE ON THE CRYOGENIC MECHANICAL PROPERTIES IN FINE-GRAINED Fe-12Ni-0.25Ti ALLOY. Hwang, S. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 52p. Dep. NTIS $5.75.

Thesis.

The phenomenological behavior of diffusion-controlled reverted austenite in a fine-grained Fe-12Ni-0.25Ti cryogenic alloy system was investigated. The grain-refined martensite structure was exposed to a temperature within two-phase ($\alpha + \gamma$) region. The stability of equilibrium austenite was affected by the decomposition temperature. It appeared to be the redistribution of solute elements that controlled the stability. The microstructural appearance of retained austenite was examined using transmission electron microscopy. A preferential distribution of the austenite phase along the martensite lath boundaries was observed. A precipitate-correlated austenite nucleation was also found to occur. The beneficial effect of the introducing retained austenite appeared not only in the tensile elongation but also in the Charpy impact toughness at low temperatures. A degradation in the yield stress occurred after an extended holding at an intermediate temperature or after a moderate time holding at a relatively high temperature. The deterioration of strength was interpreted in terms of retained austenite stability and precipitate overaging. The retained austenite did not improve K_{IC} at 77°K. Unstable crack propagation developed during the fracture toughness tests of most specimens containing retained austenite phase. (MCW)

25168 (LBL-3543) DENSIFICATION AND ELECTRICAL PROPERTIES OF CONTROLLED STOICHIOMETRY PZT. Crab-

tree, K. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 33p. Dep. NTIS $4.75.

Thesis.

The influence of a controlled PbO atmosphere during sintering on the densification and electrical properties of undoped, niobium, and tungsten doped samples of $PbZr_{0.5}Ti_{0.5}O_3$ was studied. Electrical properties were found to be more strongly dependent upon extrinsic than intrinsic influences within the single phase region. Substitution of W^{6+} occurs at levels sufficient to neutralize any charged oxygen vacancies that may be present in the structure. Amounts in excess of this substitute by a reduction mechanism. (auth)

25169 (LBL-3566) NEW RESONANCE EFFECTS IN ANTIFERROMAGNETIC MnF_2. Tennant, W. E.; Bailey, R. B.; Richards, P. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 8p. (CONF-741202-16). Dep. NTIS $4.00.

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974).

A series of weak absorption lines of unknown origin was observed below the 8.7 cm^{-1} antiferromagnetic resonance (AFMR) in the far infrared transmission spectra of MnF_2 powders. These extra modes appear in powders from different sources but are not present in the single crystal samples from which powders were prepared. Impurities are therefore unlikely to be the explanation. The strongest mode, at 8.3 cm^{-1}, shows the same magnetic splittings as the AFMR in low fields, yet is apparently not present in 5 cm^{-1} microwave spectra measured at high field values. The integrated strengths of five lines observed between 7.4 cm^{-1} and 8.3 cm^{-1} increase as the particle size is reduced. Surface magnon modes were predicted in this frequency range. However, the measured dependence on surface area of the 8.3 cm^{-1} mode intensity is not rapid enough to support this interpretation. Microwave transmission spectra show a number of lines below the AFMR field with strengths comparable to that expected for surface modes. No correlation with surface area or with the infrared mode positions has yet been found. Conventional magnetostatic effects cannot account for sharp lines as far from the AFMR as those observed in the infrared spectra. (auth)

25170 (MHSMP-74-36) LONG-TERM COMPATIBILITY OF RDX WITH HNS. Period Covered: July–September 1974. Foster, P. A. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1974. Contract DA-11-173-AMC-487(A). 17p. Dep. NTIS $4.00.

For Sandia Labs., Albuquerque, NM.

A long-term compatibility study of cyclotrimethylenetrinitramine (RDX) Type B Class B and Type B Class G with hexanitrostilbene (HNS) is being conducted. The study was begun by sandwiching an RDX pellet between two HNS pellets. The sandwich was then placed in containers in a helium atmosphere and thermally aged at 60 and 100°C. The samples will be removed at preselected times during a 2 year period. (auth)

25171 (MLM-2204(TR)) NUCLEAR MAGNETIC RELAXATION SPECTROSCOPY ON BINARY TITANIUM HYDRIDES TiH_{2-x}. Schmolz, A.; Noack, F. Translated from Ber. Bunsenges. Phys. Chem.; 78: No. 4, 339-346(1974). 27p. Dep. NTIS $4.50.

Measurements are reported on the hydrogen diffusion in binary titanium hydrides, TiH_{2-x} ($x = 0.04 - 0.65$, cubic phase), by nuclear magnetic relaxation spectroscopy. The results lead to the following three conclusions: (1) The dependence of the diffusion term of the proton spin relaxation rate, $1/T_1$, on the Larmor frequency and the temperature can be described to a good approximation by a relaxation model calculated by Weaver and Van Dyke. This implies a vacancy diffusion mechanism via tetrahedral sites within the fcc metal hydride lattice and dipolar magnetic interactions between neighboring proton spins. (2) The activation energy of the diffusion process evaluated from the measurements is independent of the degree of nonstoichiometry. This supports Korn and Zamir's oscillator model for the hydrogen positions of the lattice, which suggests partly covalent Ti-H bonds. (3) At all concentrations $(2 - x)$ investigated the hydrogen diffusion coefficient obeys an Arrhenius-type equation. (auth)

25172 (ORNL-tr-2878) EXPERIMENTAL APPARATUS FOR DETERMINING THE TRIAXIAL STRENGTH OF CONCRETE: FIRST RESULTS OF EXPERIMENTS. Linse, D. Translated by R. G. Mansfield, Oak Ridge National Lab., TN, from Cem. Concr. Res.; 3: 445-457(1973). 14p. Dep. NTIS $4.00.

The testing machine for investigations on the triaxial stress-strain behavior of concrete consists of a rigid prestressed concrete frame with jacks of 2000 kN (compression) and 300 kN (tension) respectively. To avoid lateral restraint brush-bearing platens were used. The dimensions of the specimens were 10/10/10 cm. The first tests were carried out to gain experience in operating this apparatus. The results were: the deformation under triaxial compression was much higher than that under uni- or biaxial loading; the ultimate strength increases when the stress-relation almost reaches the hydrostatic pressure (6 times or more than the uniaxial strength); and the ultimate strength under repeated loading is much less than the ultimate strength under the first loading. (auth)

25173 (ORNL-tr-2881) INTERFERENCE-MICROSCOPE DETERMINATION OF BINDER IN FIBER FLEECE ELEMENTS. Hannes, H. Translated by R. G. Mansfield, Oak Ridge National Lab., TN, from Leitz-Mitt. Wiss. Tech.; 6: No. 4, 162-165(Jun 1974). 8p. Dep. NTIS $4.00.

The mechanical-technological properties of a fleece material—a fiber textile structure that is not woven but held together by a binder—depend largely on the adhesion produced by the binder between individual fibers. A thorough study of the forces of adhesion and cohesion of binders on fibers has confirmed that the behavior of the fleece as a whole, although in a highly complex way, is determined, along with other factors, by the behavior of the individual binding points. Since the strength of such a binding point also depends on its size, measurement of the binding mass or volume which, owing to the completely irregular form of the microscopically small structure, presents some difficulties. A method of interference microscopy was developed for determining the amount of binder. For practical use of the method, an interference microscope suitable for production of banded interferograms is needed. An interferogram is shown of a binding point embedded in Cellodal of two nylon fibers with PVC as binder. The interferometric measurement of volume is checked with an example using a spindle-shaped coating of a nylon fiber with PVC. (MCW)

25174 (RD/B/N-3156) CALCULATION OF SURFACE ELEMENTAL CONCENTRATIONS USING AUGER ELECTRON SPECTROSCOPY. Wild, R. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

Auger electron spectroscopy (AES) is regularly used to detect elemental species present on solid surfaces. The method used to correct the Auger peak heights to obtain a quantitative determination of the surface composition is described. An example is given for a spectrum obtained from an oxidized sample of 18/8 stainless steel. (auth)

25175 (SAND-75-0019) ELECTRICAL PROPERTIES OF DUPONT BIROX AND CERMALLOY THICK FILM RESISTORS I. Seager, C. H.; Pike, G. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1975. Contract AT(29-1)-789. 51p. Dep. NTIS $5.75.

The preparation and initial measurements on a large variety of DuPont and Cermalloy resistors are described. Three problem areas are: large fluctuations in resistor value from substrate to substrate; departure of low and high aspect ratio resistors from the values expected on a constant ohms-per-square basis; and non-uniformities in resistor conductance near electrodes. These problems represent important production process limitations. Techniques are devised to investigate the uniformity of conductivity in the fired resistors. These experiments reveal considerable non-linearities in the conductance versus thickness profiles for each material. When combined with accurate thickness measurements of many resistors printed on special, flat substrates, these data appear to explain the three anomalies without invoking the presence of resistor-electrode interactions. Other measurements made on the DuPont and Cermalloy materials are measurements of Hall effect, ac conductivity, magnetoresistance, voltage dependencies, and radiation effects. Survey data regarding possible thick film conduction mechanisms are briefly indicated. (MCW)

25176 (UCID-16675) MECHANICAL PROPERTIES OF ANNONA CHALK TO 3.8 GPa. Weed, H. C.; Heard, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1975. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

Pressure-volume (P-V) and uniaxial compression measurements were made on Annona chalk to provide mechanical properties input for calculations of the response of this oil-bearing rock to a contained high-explosive detonation. During P-V measurements to 3.8 GPa, phase transitions were found at 0.5, 1.4, and 2.4 GPa. A permanent volume decrease of 13.6% was noted after unloading from maximum pressure; this is attributed to pore collapse below 0.3 GPa. Above 0.4 GPa, the P-V loading curve is very similar to that for water-saturated Indiana limestone. The bulk modulus is a very complicated function of pressure and ranges from 1.5 GPa at 0.15 GPa pressure to 75 GPa

at 3.8 GPa pressure. In uniaxial compression tests up to 500 MPa confining pressure, the transition from brittle fracture to ductile flow occurred at about 25 MPa confining pressure. Because of work hardening in the calcite and progressive pore collapse with deformation, the shear strength at 3% axial strain increased from 14 to 100 MPa with increasing pressure. The tensile strength under atmospheric pressure varied from 1.4 to 2.0 MPa. (auth)

25177 (UCRL-51724) SOME PROPERTIES OF ADDITION-TYPE SILICONE POTTING COMPOUNDS. Bissell, E. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A summary is presented of data collected at LLL on the chemical nature and analyses; cure, physical, thermal, mechanical, and electrical properties; aging and reversion; and modification of several recently developed addition-type silicone potting compounds (Dow Corning 93-109, 93-119, 93-120, and 93-122). (auth)

25178 (UCRL-76463) APPLICATION OF THREE-DIMENSIONAL FINITE ELEMENT ANALYSES TO THE MICROMECHANICS OF FIBROUS COMPOSITE MATERIALS. Larder, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 6p. (CONF-741001-43). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

The state of stress in a typical microscopic unit cell within a composite structure was examined using 3-dimensional finite element models. The models consist of the region in the vicinity of two non-parallel fibers including the fibers and the binder or matrix material. The results from these calculations were displayed using some unique data reduction techniques that allow various stress components to be displayed at element interiors. Both 3-dimensional finite element techniques and computer-generated 16-mm movies were used to examine a complex state of stress. Contours representing constant stress values are plotted on a line drawing of the finite element mesh in which the hidden lines were removed. Motion picture display has proved useful in viewing the state of stress as the model is rotated or as portions are removed to expose the stresses at internal points in the structure. (auth)

25179 (UCRL-76474) DETONATION CALCULATIONS IN EXPLOSIVE MIXTURES. Sutton, S. B.; McCauley, E. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 7p. (CONF-741001-52). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Interest in dynamic loading of structures subject to internal explosion of combustible gas mixtures has prompted the development of sophisticated tools for analyzing gaseous combustion from both one-dimensional and two-dimensional standpoints. The calculations are performed using the CCC and TUTU2 computer codes on the CDC-7600. CCC, determines the one-dimensional Chapman–Jouguet detonation parameters. The code accepts an arbitrary mixture of reactants at a specified initial temperature and pressure and computes the equilibrium products and detonation parameters, accounting for generalized species dissociation as well as recombination. The results are valid for an infinite, homogeneous medium. In order to treat the effect of boundaries, the two-dimensional Lagrangian computer code TUTU2 is used, employing a modified high explosive equation-of-state and input from the CCC computer code to model the detonation process and wall interaction. A sample calculation is given demonstrating the compatibility between the two calculations as well as demonstrating the code coupling process. (auth)

Physics and Engineering

25180 (AERE-M-2648) SUB-MODULAR MULTI-CHANNEL ANALYSER. Phillips, G. I. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1974. 25p. Dep. NTIS (US Sales Only) $4.25. UK 50 pence.

The report describes how the facilities offered by the Harwell 6000 Series Modular Unit System can be used to provide a range of multi-channel analyzers and multiscalar systems oriented to a specific operational requirement. This is achieved simply and effectively by changing the wiring on a back plane of the assembly and making an appropriate selection of modules. A popular multi-channel analyzer built up by this technique is described in some detail. (auth)

25181 (AERE-R-7868) SIDE ENTRY SPECIMEN STAGES FOR THE EM7 ONE MILLION VOLT ELECTRON MICROSCOPE. Sansom, H. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1974. 15p. Dep NTIS (US Sales Only) $4.00. UK 50 pence.

The advantages of side entry specimen stages over the more conventional top entry systems for certain types of work are discussed. Two designs of side entry stages for the A.E.I. EM7 one-million-volt electron microscope are described and their performance assessed. (auth)

25182 (AERE-R-7899) COMPUTER CONTROLLED SYSTEM FOR THE RECORDING AND PROCESSING OF AUGER EMISSION SPECTRA. Bishop, H. E. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1974. 20p. Dep. NTIS (US Sales Only) $4.00. UK 50 pence.

A computer control system for the recording of Auger spectra is described and the general requirements of a data processing system for use with AEA are discussed. The automated Auger spectrometer is fitted to a field emission scanning electron microscope that contains a thermionic electron gun (VG Microscopes Ltd., HBA200). Preliminary results obtained from the system are presented and it is shown that useful AES may be carried out with a field emission gun at beam currents less than 10^{-9} amps. (auth)

25183 (CEA-R-4589) LOGIC FUNCTIONS FOR MAGNETIC BUBBLE DEVICES. Bonnes, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). Jan 1975. 87p. (In French). Dep. NTIS (US Sales Only) $7.50.

Thesis. Submitted to Univ., Grenoble, France.

An investigation was made of the possibility of performing logic functions using the interaction of circular magnetic domains. An apparatus was built that allows the study of the dynamic behavior of bubble domains. This is accomplished by means of the Faraday effect in conjunction with a stroboscopic technique. A method is proposed that allows precise calculations of the magnetostatic interaction between 2 bubbles or between a bubble and permalloy circuit. The calculations were helpful for designing logic gates. A number of and/or gates were fabricated and tested successfully. (tr-auth)

25184 (CEA-R-4646) CONTRIBUTION TO THE STUDY OF WAVES AND SHOCK WAVES IN SOILS. Meunier, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jan 1975. 230p. (In French). Dep. NTIS (US Sales Only) $14.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble, France.

The thesis deals with propagation of waves and weak shock waves in soils, and of rheological properties of soils subjected to high speed of strain. Propagation of waves in a one-dimensional medium is studied with linear-elastic, nonlinear, visco-elastic, and plastic rheological laws. Propagation of waves in a three-dimensional medium is approached. Many examples illustrate the main conclusions. Then the experimental results obtained on clay under dynamic solicitations are given: estimation of a mean strain of clay samples by the fall of a weight, high speed cinematography and visualization of plastic wave, use of Hopkinson pressure-bar. Theories are applied to the problem of pile-driving and to the attenuation of shock wave into snow. (tr-auth)

25185 (LBL-1876) I. GENERATION OF FAR-INFRARED RADIATION BY OPTICAL RECTIFICATION OF PICOSECOND LIGHT PULSES AND BY MIXING OF TWO TUNABLE DYE LASERS. II. Theoretical Study of Coherent Phonon Generation by Optical Means in a One-Dimensional Superlattice. Yang, K. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 157p. Dep. NTIS $11.00.

Thesis.

In Chapter I far-infrared radiation generated in a $LiNbO_3$ crystal by picosecond light pulses from a mode-locked Nd : glass laser was observed. In one experiment a 0.77 mm thick $LiNbO_3$ crystal was used to rectify the laser pulses. The resulting spectrum showed peaks of descending power at 2, 6.5, and 10.5 cm^{-1}. In a second experiment the $LiNbO_3$ was oriented to obtain forward phase-matching at 13.5 cm^{-1} and backward phase-matching at 6.5 cm^{-1}. Both peaks were observed and were in agreement with the theoretical calculation. In Chapter II, with the help of the lattice momentum, phase-matched optical generation of coherent phonons with frequencies higher than 50 GHz appears feasible. Two cases were calculated: direct conversion of millimeter or submillimeter photons in a piezoelectric superlattice and optical mixing of two laser beams in a non-piezoelectric superlattice. In the first case, an efficiency of 10^{-4} for photon-to-phonon power conversion can be achieved using an epitaxial GaAs : GaP superlattice of 100 unit cells. In the second case, longitudinal phonon power of 1 mW can be generated by the mixing of two 10 MW/cm^2-laser beams in a KCl : CdS superlattice of 100 vacuum deposited layers. The first-order effect on the generated phonon power due to ±2% random errors in the periodicity of the superlattice was calculated. (MCW)

25186 (LBL-3393) VORTEX BLOBS IN A SQUARE CAVITY APPLICATION OF CHORIN'S METHOD. Shestakov, A. I. (Calif-

fornia Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1974. Contract W-7405-eng-48. 42p. Dep. NTIS $4.00.

Chorin's method of solution of the Navier-Stokes equations, using vorticity blobs receiving both a deterministic as well as a random push, is applied to the two-dimensional problem of a flow inside a square cavity where one side moves in its own plane with a unit velocity. Results are presented for a Reynolds number of 10^3. (auth)

25187 (NP-20298) TWO-MULTIPLY-EXPOSED HOLOGRAM APPLICATION FOR OBTAINING INTERFEROGRAMS WITH DIFFERENT ORIENTATION AND BANDWIDTH. Smirnov, V. G.; Smirnov, A. G.; Stasel'ko, D. I. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The interference diagram obtained from interferograms with different orientation and bandwidth from one hologram and recorded by a double exposure method is described. The diagram operation is based on space separation of restored waves and their mutual position changing simultaneously. (tr-auth)

25188 (RD/B/N-3168) RECALIBRATION OF TEMPERATURE CONDITIONS IN THE BERKELEY NUCLEAR LABORATORIES HIGH VOLTAGE ELECTRON MICROSCOPE. Buswell, J. T.; Rickards, G. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Methods are described for the calibration of the temperature conditions in the high voltage electron microscope. Heating holders are calibrated in the microscope using a thermocouple spot welded to a dummy specimen. An indication of the temperature of the microscope stage can be obtained by monitoring the temperature of the top plate of the objective lens. Results of the calibration of the temperature rise of the specimen holder due to direct electron beam heating of the objective aperture are given. For holder temperatures in the range 400 to 600°C, a rise in temperature of up to 20°C can be obtained. (auth)

25189 (SAND-74-0138) ELECTROMAGNETIC EXTENDED-RAIL GUIDANCE. Boverie, B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 24p. Dep. NTIS $4.25.

The technical feasibility of electromagnetic extended-rail guidance (EMERG) for surface-to-surface missile applications was studied. The system was configured to minimize rocket cost by performing the processing on the ground and to reduce the effect of errors by proper selection of parameters and procedures. Hardware requirements and overall system accuracy were determined by means of a system simulation. (auth)

25190 (SAND-74-0315) AEROBALLISTIC DESIGN AND DEVELOPMENT OF THE TERRIER-RECRUIT ROCKET SYSTEM WITH FLIGHT TEST RESULTS. Rollstin, L. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1975. Contract AT(29-1)-789. 87p. Dep. NTIS $7.50.

Aerodynamic, performance, and trajectory analyses with flight test results for the Terrier-Recruit rocket system are reported. The Terrier-Recruit is a two-stage, solid-propellant rocket system capable of boosting a 70-lbsm (32-kg) payload to velocities of 8500 to 9000 ft/sec (2600 to 2750 m/sec) in 6.5 sec (maximum velocity altitude is nominally 10,000 ft msl, 3050 m msl). (auth)

25191 (UCID-16676) PRELIMINARY REPORT ON A MODEL FOR INCIPIENT SPALL. Cochran, S. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Feb 1975. Contract W-7405-eng-48. 18p. Dep. NTIS $4.00.

A computational model to describe spall is presented. The important features are a spall strength and a damage function that modify material properties in tension. The model can be interpreted as fracture occurring by nucleation, growth, and coalescence of microcracks. The predictions of the model are compared to experiments in copper and the agreement is quite good. Future developments for the model are indicated. (auth)

25192 (UCRL-51666) COMPUTERIZATION OF A VACUUM BRAZING FURNACE USING A MICROPROCESSOR. Berg, G. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Aug 1974. Contract W-7405-eng-48. 31p. Dep. NTIS $4.75.

The design process for converting an existing manually operated vacuum brazing furnace into a computer controlled automatic system is presented. Emphasis is placed on hardware design. The existing system and operating procedure, as it relates to the automatic system design, is discussed. The use of a computer, and the decision to use a microprocessor, are justified. The paper discusses in detail the computer-compatible SCR driver circuit. A generalized design for the system software and control algorithm is given, along with the scaling routines for displaying the furnace data. (auth)

25193 (UCRL-51698) VENT: A PROGRAM TO SIZE AND BALANCE EXHAUST VENTILATION SYSTEMS. Toy, A. J.; McDermott, H. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

A computer code that calculates balanced flows in exhaust ventilation systems and calculates the fan size needed to achieve specified performance is documented. The code was modified to allow balancing and sizing when new ducting is added to an existing system. (auth)

25194 (UCRL-51723) INTEGRAL REPRESENTATIONS FOR FIELDS DUE TO SOURCES ON OPEN SURFACES WITH APPLICATIONS TO END CAPS. Poggio, A. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Dec 1974. Contract W-7405-eng-48. 24p. Dep. NTIS $4.25.

The exact integral representation of fields due to sources on open surfaces is developed. The expression is taken to the thin wire limit. The treatment of end caps is considered in the context of these expressions. Functional forms for the cap surface current distributions that do not require a complicated surface integral are derived. Finally, a constraint on the ratio of current to its derivative at the join (intersection of end cap surface and wire surface) is arrived at. (auth)

25195 (UCRL-76461) MODIFICATION AND COUPLING OF STRUCTURES FOR DYNAMIC ANALYSIS. Hallquist, J. O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 8p. (CONF-741001-42). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

UMS, an acronym for Undamped Modification-Synthesis, is a computer code for modifying and coupling structural systems. The analytical procedure employed in the code utilizes the modal characteristics of the subsystems in a stepwise interconnection and modification technique. At each step, a characteristic equation is solved that is ideally suited to a stable numerical solution by the Newton–Raphson method. A bisection procedure is used to obtain the necessary starting values. Any degree of approximation is permitted, but if desired the exact solution can be calculated. Mass, stiffness, and rigid ties (modifications) are allowed. Rigid ties permit degrees of freedom to be constrained to the same displacement or to zero. A truss modification and an analysis of a 192 DOF 3-D frame are solved for possible applications of the method and code. (auth)

25196 (UCRL-76473) CONSTRAINED OPTIMIZATION IN ENGINEERING DESIGN. Radcliffe, C. W.; Comfort, W. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1974. 9p. (CONF-741001-51). Dep. NTIS $4.00.

From CUBE symposium; Livermore, California, USA (23 Oct 1974).

Solution of the constrained optimization problem is accomplished by Powell's technique coupled with sequential minimization using penalty functions. The Powell algorithm is a numerical direct search method, hence analytical derivatives are not required. The code is user oriented and includes several unique features: (1) normalization of constraints, (2) initial weighting of the constraint functions with respect to the objective function, and (3) reduction of the convergence tolerances to insure that a constrained minimum has been found. The technique was successfully applied to a broad class of problems in engineering and physics including multivariable one-dimensional hydrodynamic calculations, pressure vessel design, synthesis of mechanisms, structure design, turbine design, and model identification. Specific examples are included. (auth)

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